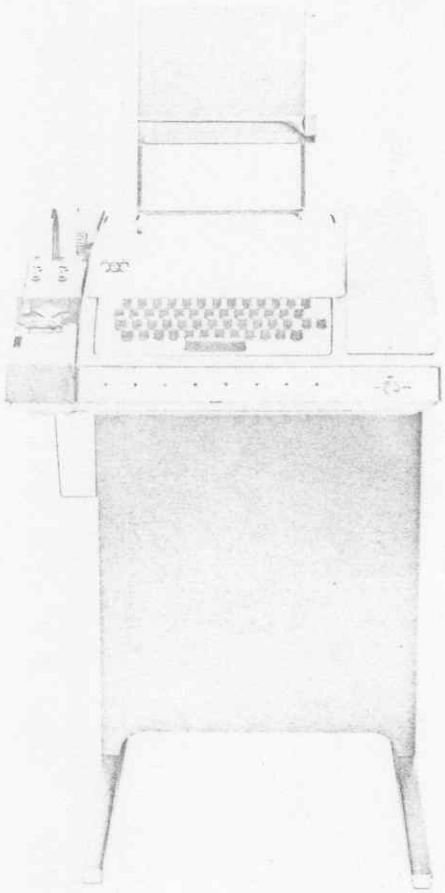
OPERATING AND SERVICE MANUAL

# 2752A
# TELEPRINTER



HEWLETT hp PACKARD

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# OPERATING AND SERVICE MANUAL

# 2752A

## TELEPRINTER

Serial Numbers Prefixed: 630-

Note

This manual is available separately as HP part no. 02752-9004 or with the Teletype Corporation ASR 33 manual as HP part no. 02752-9002.

02752-9004

HEWLETT-PACKARD COMPANY
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Printed: NOV 1970

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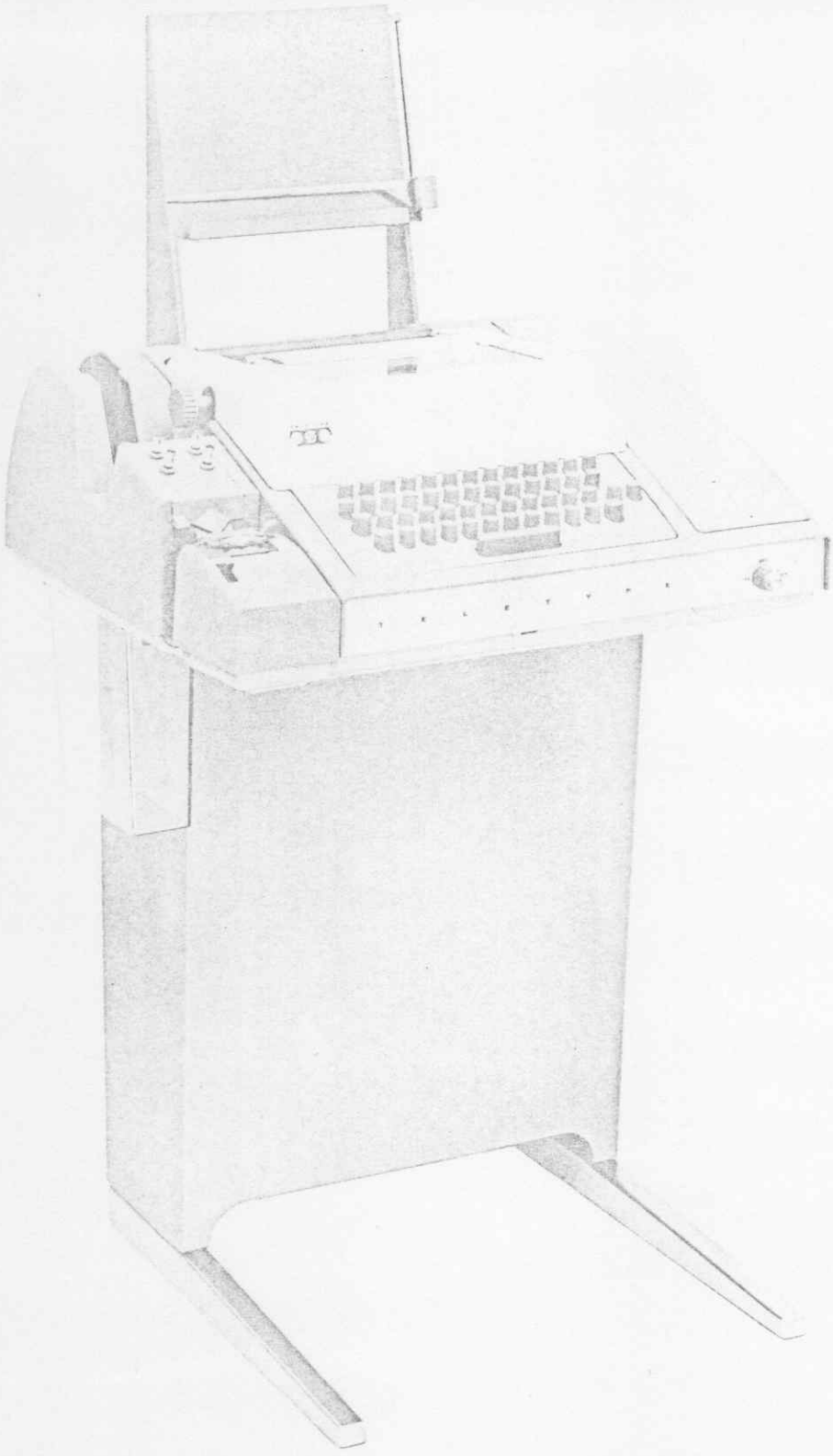

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Figure 1-1. Hewlett-Packard 2752A Teleprinter

# SECTION I

# GENERAL INFORMATION

## 1-1. INTRODUCTION.

1-2. This operating and service manual contains general information, installation and operating procedures, theory of operation, maintenance instructions, and replaceable parts lists for the Hewlett-Packard 2752A Teleprinter.

## 1-3. GENERAL DESCRIPTION.

1-4. The HP 2752A Teleprinter is a modified Teletype ASR33-TZ Teletypewriter Set. The teleprinter is made up of a typewriter, a paper tape punch, and a paper tape reader. The unit provides a means for loading data into a computer or other remote device by either manually operating the typewriter keyboard or by reading a punched paper tape in the teleprinter tape reader. The unit can also record received data by punching the data on a paper tape and/or typing the data on paper.

1-5. The modifications to the Teletype ASR33-TZ Teletypewriter Set make the basic unit compatible with Hewlett-Packard computers. The changes include the addition of a printed-circuit card assembly, an elapsed time indicator, a computer interface cable, and associated wiring changes.

1-6. Detailed information for the basic unit is given in the three-volume Teletype manual, which is available either separately or as a part of this manual. In cases where information in this manual differs from the information in the Teletype manual, follow this manual. Differences occur in unpacking and installation instructions and in specified maintenance intervals.

## 1-7. IDENTIFICATION.

1-8. Hewlett-Packard uses four digits and a letter (0000A) for standard unit model designations. Options installed as factory modifications to a standard unit are identified by a three digit suffix following the model designation (0000A-000). If the model number on your unit does not agree with that on the title page of this manual, there are differences between your unit and the unit described in this manual. These differences are described in manual supplements available at the nearest HP Sales and Service Office.

1-9. A two-section eight-digit serial number (000-00000) identifies each unit. The first three digits are a prefix number used to identify a particular unit configuration. This prefix does not change unless unit changes are made. The last five digits identify each specific unit. If the serial number prefix on your unit does not agree with that shown on the title page of this manual, there are differences between your unit and the unit described in this manual. These differences are described in manual supplements available at the nearest HP Sales and Service Office.

1-10. Printed-circuit card revisions are identified by a letter, a date code, and a division code stamped on the board (e.g., A-1055-22). The letter code identifies the version of the etched trace pattern on the unloaded board. The date code (middle digits) refers to the electrical characteristics of the loaded board. The division code (last two digits) identifies the Hewlett-Packard division that manufactured the board. If the date codes stamped on the printed-circuit boards do not agree with the date code shown on the schematic diagrams in this manual, there are differences between your boards and the boards described in this manual. These differences are described in manual supplements available at the nearest HP Sales and Service Office.

## 1-11. EQUIPMENT SUPPLIED.

1-12. Equipment supplied with each teleprinter includes one roll of teleprinter paper (part number 9280-0046), one roll of paper tape (part number 9280-0063), and a lubrication kit (part number 5080-6610).

## 1-13. OPTIONS.

1-14. The teleprinter may include option 001 to allow operation from 230-volt 50-hertz power. A Teletype ASR33-TAC is supplied in place of the standard ASR33-TZ Teletypewriter Set, and a separate power transformer is included.

## 1-15. SPECIFICATIONS.

1-16. Table 1-1 lists technical specifications for the teleprinter.

Table 1-1. Teleprinter Specifications

Tape Punching and Reading Speed:
10 characters per second.

Typing Speed:
100 words per minute (maximum).

Tape Code:
Eight-channel on one-inch paper tape.

Data Transfer:
Bit serial, eight-bit code.

Platen:
Friction feed.

Power Required:
115 volts ± 10%, 60 ± 0.5 Hz, single-phase, 230 watts.
Option 001: 230 volts ±10%, 50 ± 0.5 Hz, 230 watts.

Power Supplied by Computer:
+12 volts and -12 volts dc.

Operating Conditions (limits imposed by paper tape):
Ambient Temperature: 10° to 40° C (50° to 104° F).
Relative Humidity: 20 to 80% within temperature range above.

Dimensions:
33 inches (838 mm) high, 25-1/2 inches (648 mm) wide, 18-1/2 inches (470 mm) deep.

Weight (with stand):
Net: 77 lb (34,7 kg).
Shipping: 92 lb (41, 8 kg).

# SECTION II

# INSTALLATION

## 2-1. INTRODUCTION.

2-2. This section provides information on unpacking, inspection, shipping, and installation for the teleprinter.

## 2-3. UNPACKING AND INSPECTION.

2-4. If the shipping carton is damaged upon receipt, request that the carrier's agent be present when the unit is unpacked. Inspect the unit for damage (scratches, dents, broken parts, etc.). If the unit is damaged and fails to meet specifications, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately. (Sales and Service Offices are listed at the back of this manual.) Retain the shipping container and the padding material for the carrier's inspection. The Hewlett-Packard Sales and Service Office will arrange for the repair or replacement of the damaged unit without waiting for any claims against the carrier to be settled.

## 2-5. PREPARATION FOR USE.

2-6. Since the teleprinter is shipped partially disassembled, the unit must be assembled before use. The following paragraphs contain an assembly procedure and procedures for loading tape, typewriter ribbon, and paper in the teleprinter.

## 2-7. ASSEMBLY PROCEDURE.

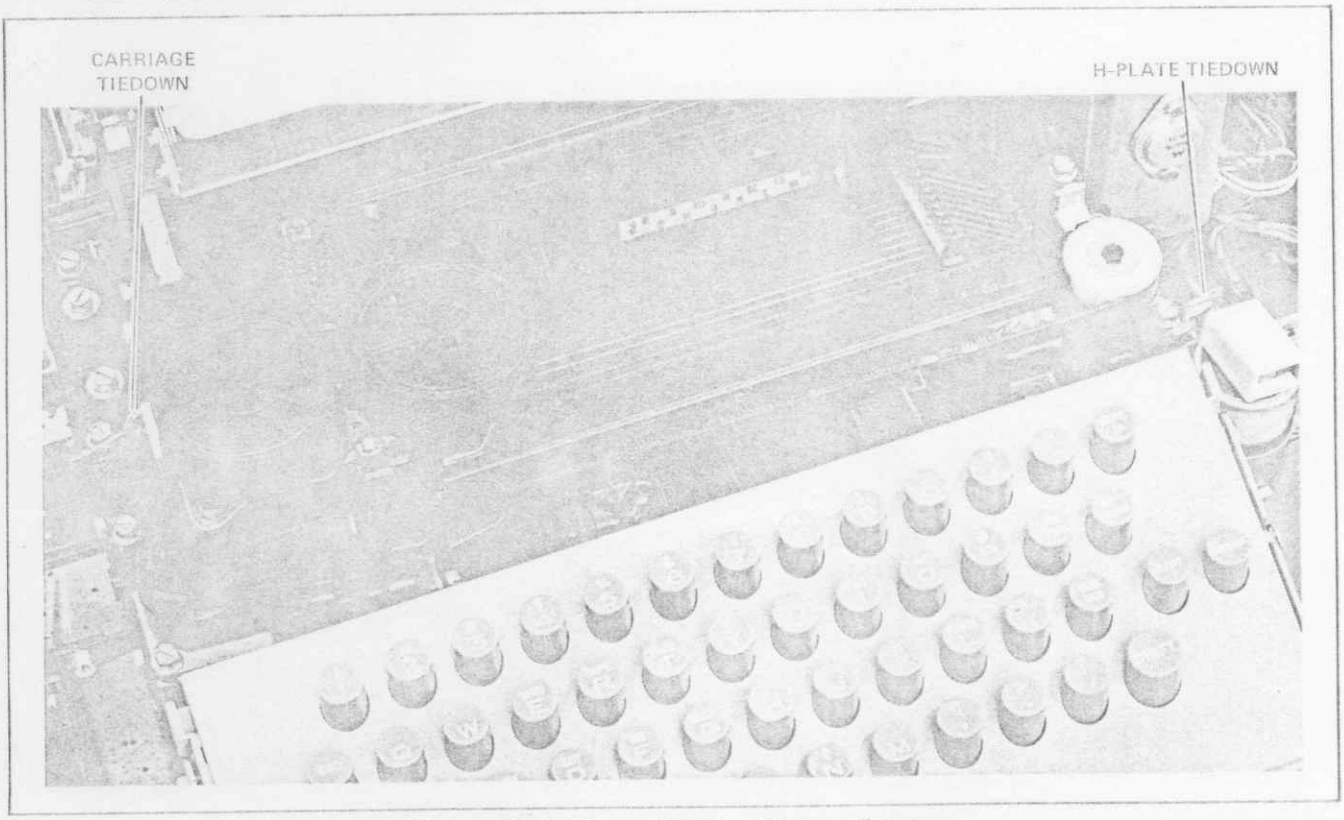
2-8. To assemble the teleprinter, proceed as follows:

a. Place the teleprinter, with shipping pallet attached, on a workbench. Remove the seven screws on underside of pallet and lift unit from pallet. Remove tape that holds teleprinter cover in place.

b. Remove knob from front-panel LINE/OFF/LOCAL switch by pulling knob straight out. Remove nameplate containing LINE/OFF/LOCAL nomenclature by pulling nameplate down and out.

c. Unfasten teleprinter cover by removing the four screws that were uncovered when nameplate was removed, the three screws on rear of unit, and the small screw on the lower rear edge of the tape reader cover. Carefully remove teleprinter cover.

d. Remove and discard the material that is used to tie the printing carriage to the left side of the typing unit and the H-plate to the right side of the typing unit. (See figure 2-1.)




2089-24 Figure 2-1. Carriage and H-Plate Tiedown Points

e. Remove spring clip from tape reader upstop shoulder screw as shown in figure 2-2.

f. Visually inspect the teleprinter for obvious defects.

g. Remove the two screws at top of teleprinter stand rear panel. Remove panel by lifting panel up and out. Remove the four screws and washers from bag attached to the teleprinter stand.

h. Support front of teleprinter and position unit on stand so teleprinter and stand rear panels are vertically aligned. Attach teleprinter to stand by inserting the four screws into teleprinter base through the holes in stand. Use a single washer for each screw. Level stand by adjusting leveling screws under rear corners of stand.

i. Clip tape reader power pack to the inside top-front flange of stand as shown in figure 2-3. Connect short cable with transparent covering to power pack connector.

j. Mount step-down transformer (option 001 instruments only) to inside bottom of stand with suitable hardware. Insert teleprinter power plug in receptacle on transformer.

k. Replace stand rear panel and secure in place with screws previously removed. Replace teleprinter cover and secure in place with screws removed in step "c".

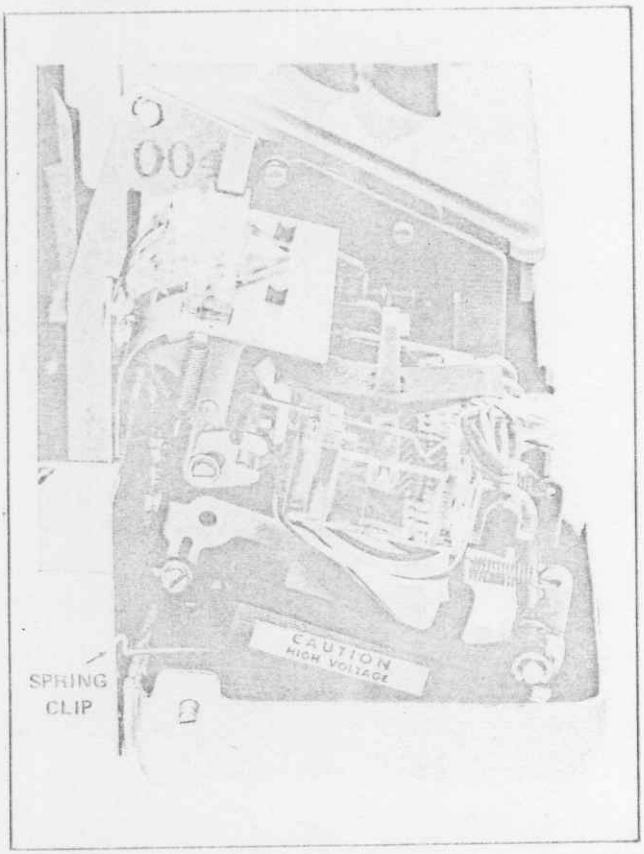



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Figure 2-2. Tape Reader Retaining Clip

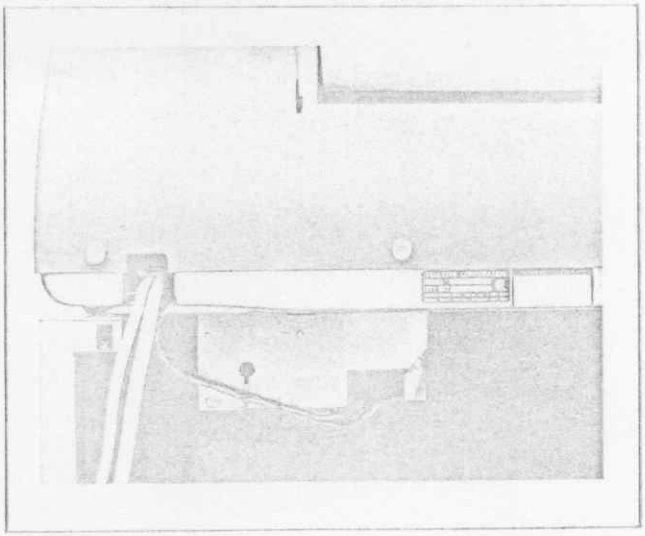

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Figure 2-3. Power Pack Installation

l. Place the long paper-roll spindle in the slots behind typewriter platen and place the small paper-roll spindle in holder directly behind tape punch. Replace platen knob.

m. Mount copy holder on back of teleprinter by inserting copy holder tabs into matching slots on teleprinter. Push down on holder until tabs are fully seated.

n. Mount chad box under tape punch by inserting back of chad box flange between stand and teleprinter base. Push chad box to rear of stand until lip on front of box touches stand.

o. Replace nameplate on front of teleprinter. Make certain that top edge of nameplate is behind the small lip on cover and that bottom of nameplate rests on top of the two projections on the teleprinter base. Push knob onto shaft of LINE/OFF/LOCAL switch and set switch to OFF position.

## 2-9. TELEPRINTER RIBBON, PAPER, AND TAPE LOADING.

2-10. Install teleprinter ribbon (part no. 9282-0079) according to instructions given in paragraphs 3.07 thru 3.10 of section 574-100-201 in volume 1 of the Teletype manual. Install paper (part no. 9280-0046) according to instructions given in paragraphs 3.11 thru 3.15 of section 574-100-201 in volume 1 of the Teletype manual. Install paper tape (part no. 9280-0063) as follows:

a. Connect teleprinter power cable to appropriate power source.

b. Press tape punch ON pushbutton.

c. Drop new tape reel into tape punch with end of tape coming up from the rear and extending over the top of roll.

d. Thread beginning of tape as far as possible into tape punch head.

e. Set LINE/OFF/LOCAL switch to LOCAL and press HERE IS key several times until tape feeds through tape punch.

## 2-11. POWER AND SIGNAL CABLE CONNECTIONS.

2-12. The standard teleprinter plugs directly into a 115-volt 60-hertz power outlet. The teleprinter equipped with option 001 includes a step-down transformer to convert 230-volts to 115-volts. The step-down transformer power cord plugs directly into the 230-volt 50-hertz outlet, and the teleprinter power cord plugs into the transformer.

2-13. A single signal cable is provided with the teleprinter for interfacing the teleprinter to the computer. The free end of the signal cable is equipped with a hooded connector. When installing the teleprinter, pass the hooded connector through the opening in the back of the computer and plug onto the interface card for the teleprinter.

## 2-14. INSTALLATION CHECKOUT.

2-15. The following paragraphs provide a quick check of the teleprinter's basic operating functions. The checkout consists of a sample message that is typed and simultaneously punched on paper tape. The paper tape is then placed in the tape reader, and the message is printed again from the tape. Both printed messages must be exactly alike. Perform the checkout as follows:

a. Verify that teleprinter power cable is connected to power outlet (115-volt 60-Hz for standard unit; 230-volt 50-Hz for option 001).

b. Turn LINE/OFF/LOCAL switch to LOCAL and press tape punch ON pushbutton.

c. Using the typewriter keyboard, type the following message:

THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK 1234567890.

Press RETURN key, press LINE FEED key, and then type the message again. The tape punch should simultaneously punch the message into the tape.

d. The printed message should be exactly as typed. If it is not, the typing unit is malfunctioning. Refer to Teletype manual and repair unit before proceeding to step "e".

e. Press HERE IS key to generate about six inches of blank tape. Remove the newly punched tape and insert tape into tape reader.

f. Set tape reader control lever to START. The tape reader should read the tape, and the typewriter unit should print the message exactly as it was originally typed; if not, the tape punch or tape reader is malfunctioning. Refer to Teletype manual and repair the unit.

g. If any repairs were required, repeat all steps of this checkout procedure to ensure proper operation.

## 2-16. SHIPPING AND STORAGE INSTRUCTIONS.

2-17. If the unit is to be shipped to Hewlett-Packard for service or repair, attach a tag to the unit identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the unit.

2-18. Place the unit in the original container if available. If the original container is not available, a suitable container and packing material can be purchased from a local Hewlett-Packard Field Office.

2-19. If the original container is not used, wrap the unit in heavy paper and place it in an inner container. Place adequate packing material around all sides of the unit and place a cardboard strip over the front panel and keyboard. Place the unit and inner container in a heavy carton or wooden box and bind with strong tape or metal bands. Mark the shipping container "FRAGILE."

Note

In any correspondence, identify the unit by model number and serial number prefix. Refer any questions to the nearest Hewlett-Packard Field Office.

2-20. If the teleprinter is to be stored for any length of time, pack the unit as described above to protect it against accidental damage.

# SECTION III

# OPERATION

## 3-1. INTRODUCTION.

3-2. This section contains a description of the teleprinter operating controls and instructions for operating the teleprinter in various modes.

CAUTION

The teleprinter must not be used for more than five hours a day or thirty hours a week. Damage to equipment may result if limits are exceeded.

## 3-3. OPERATING CONTROLS.

3-4. Figure 3-1 shows the teleprinter operating controls. Numbers preceding control descriptions correspond to index numbers of the various controls.

## 3-5. OPERATING INSTRUCTIONS.

3-6. The following paragraphs contain instructions for operating the teleprinter in various modes. For each of these procedures, it is assumed that the teleprinter has been installed and prepared for use in accordance with section II of this manual.

3-7. PRINT FROM COMPUTER.

3-8. To print data that is output by the computer, set the LINE/OFF/LOCAL switch to LINE. The computer now has direct control of the teleprinter printing function.

3-9. PRINT AND PUNCH FROM COMPUTER.

3-10. To print and punch data from the computer, press tape punch ON pushbutton, and set LINE/OFF/LOCAL switch to LINE. The computer now has direct control over printing and tape punching functions. After use, press tape punch OFF pushbutton.

3-11. TYPE INTO COMPUTER.

3-12. To type data into the computer from the teleprinter, an indication that the computer is ready to receive data is required. When the computer indicates it is ready for data (by causing teleprinter to type READY, RUN, etc. depending on software in use), enter data directly from typewriter keyboard. If an error is made, sequentially press ESC or RUB OUT (depending on software in use), RETURN, and LINE FEED keys; the computer will disregard all data on the line containing the error.

Note

A non-printing key such as LINE FEED must follow the pressing of the RETURN key. This prevents possible printing of a character at random.

3-13. READ TAPE INTO COMPUTER.

3-14. To read punched tape into the computer, open tape lid on tape reader and insert tape. Verify that feed holes on tape match with pins on feed wheel, and close tape reader lid. Set LINE/OFF/LOCAL switch to LINE and tape reader control lever to START. After tape has been read, set control lever to STOP.

3-15. PUNCH TAPE FROM TYPEWRITER.

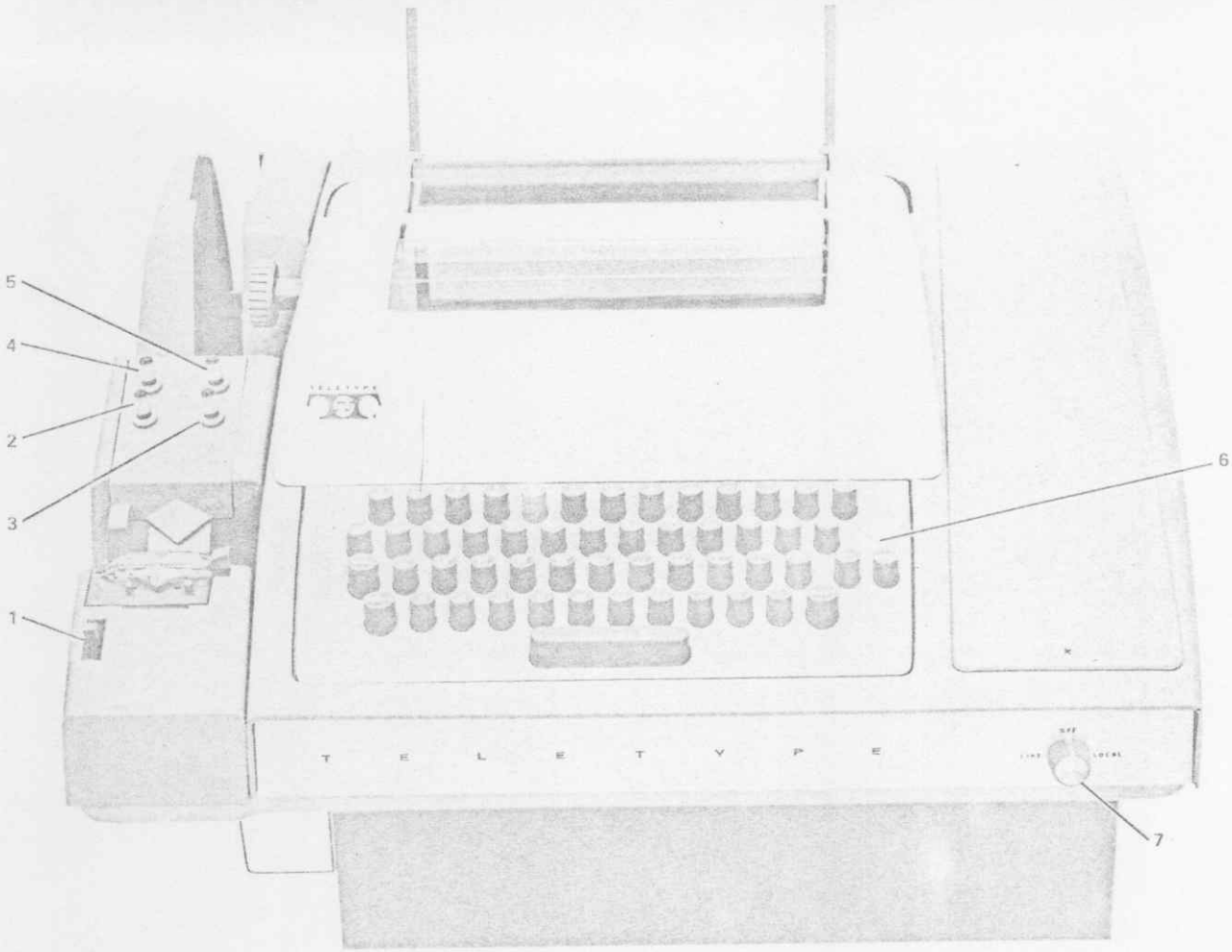
3-16. To punch tape from the typewriter without affecting computer memory, set LINE/OFF/LOCAL switch to LOCAL, press tape punch ON pushbutton, and type message. If an error is made, press RUB OUT, RETURN, and LINE FEED keys. The computer will ignore the erroneous line. When finished, press tape punch OFF pushbutton.

3-17. READ PUNCHED TAPE.

3-18. To read a punched tape without affecting the computer, insert tape in reader as described in paragraph 3-14. Set LINE/OFF/LOCAL switch to LOCAL and tape reader control lever to START. When the typewriter finishes typing the tape contents, set tape reader control lever to STOP.

3-19. DUPLICATE PUNCHED TAPE.

3-20. Install the tape to be reproduced in the tape reader as described in paragraph 3-14. Set LINE/OFF/LOCAL switch to LOCAL, press tape punch ON pushbutton, press HERE IS key twice to generate a tape leader, and set tape reader control lever to START. When the duplicate tape is completely punched, set tape reader control level to STOP and press HERE IS key twice to generate trailer tape. Press tape punch OFF pushbutton and return LINE/OFF/LOCAL switch to OFF.




1. START/STOP/FREE switch: Controls tape reader functions. In FREE position, feed ratchet releases for tape positioning.
2. B. SP. pushbutton: Backspaces punched tape one feed hole each time pushbutton is pressed.
3. ON pushbutton: Mechanically engages tape drive mechanism to permit a punching operation.
4. REL pushbutton: Releases tape guide assembly from feed wheel to allow tape removal from punch.
5. OFF pushbutton: Disengages tape drive mechanism to prevent a punching operation.
6. Typewriter keyboard: Most keys are self-explanatory; exceptions are as follows.
   a. HERE IS key is used to generate several inches of blank tape from the tape punch.
   b. CTRL key selects upper keytop function when pressed with one of the following keys:
      (1) WRU (who are you) key identifies answering station by tripping the station answer back mechanism.
      (2) X OFF key turns off originating station transmission facilities.
      (3) EOT (end of transmission) key disconnects both sending and receiving stations.
      (4) RU (are you) key requests identification from stations.
      (5) FORM key provides sprocket feedout at both stations.
   c. SHIFT key selects upper keytop symbol when pressed at same time as a graphic symbol key.
   d. LINE FEED key rotates platen one line and signals the computer that the teleprinter is at the end of a statement.
   e. RUB OUT key generates a marking code to obliterate character errors on punched tape.
   f. BELL key rings a bell at both sending and receiving stations.
   g. ESC (escape) key provides an optional code used for nonprinting (control) functions.
   h. TAPE, TAB, and VT keys are not presently used.
7. LINE/OFF/LOCAL switch: Controls overall function of teleprinter. The computer is connected in LINE position and disconnected in LOCAL position.

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Figure 3-1. Operating Controls

# SECTION IV

# THEORY OF OPERATION

## 4-1. INTRODUCTION.

4-2. This section provides information on the American Standard Code for Information Interchange (ASCII) data code used by the teleprinter, descriptions of the teleprinter functional sections, and a detailed circuit description for the teleprinter.

## 4-3. ASCII DATA CODE.

4-4. ASCII data code provides an 11-bit transmission pattern. Eight bits are used to gain intelligence. When 1 start bit and 2 stop bits are added to the 8 intelligence bits, a total of 11 bits are transmitted (or received) for each character. The eight intelligence bits are provided by pressing a teleprinter key or reading a punched tape; the three start and stop bits are automatically provided by the teleprinter distributor each time a character is transmitted.

4-5. The first seven of the eight intelligence bits are used for data; the eighth bit is an error detection (parity) bit. This arrangement provides $2^7$ or 128 different coding combinations. Only 64 of these combinations are used to print characters. The remaining 64 are either assigned to control (nonprinting) functions or reserved for future use.

## 4-6. FUNCTIONAL DESCRIPTION.

4-7. The teleprinter is made up of four basic units, each of which are described functionally in the following paragraphs.

a. Keyboard.
b. Printer.
c. Tape reader.
d. Tape punch.

### 4-8. KEYBOARD.

4-9. Pressing a key on the teleprinter keyboard actuates a key lever in the keyboard mechanism. The downward movement of the key lever sets up a mechanical arrangement of the codebars which selects the particular character for printing. The codebars also close keyboard contacts which complete the electrical circuit for the marking or logic 1 bits for that character.

4-10. The code combination provided by the keyboard contacts is wired in parallel to the distributor mechanism. The distributor rotates so that each segment on the distributor disc is sampled once every rotation for 9.09 milliseconds. A start bit, which is always a space or logic 0, comes first; the eight intelligence bits are next; the two stop bits, which are always marks or logic 1's, complete the cycle for one character. The distributor mechanism, therefore, translates the parallel input from the keyboard contacts to serial format for application to the computer.

### 4-11. PRINTER.

4-12. The printer may be controlled from the keyboard, the tape reader, or from external signals. The printer can print characters, perform functions, such as line feed and carriage return, and control punching of data received from the keyboard, the tape reader, or the computer.

4-13. Although data is transmitted via the keyboard distributor mechanism, the printer selector mechanism must be enabled to print data received from an external device. The selector magnet driver (SMD) card enables the selector mechanism. The card does this by energizing a selector magnet for a mark condition and de-energizing the selector magnet for a space condition. The selector mechanism converts the electrical SMD output to a mechanical arrangement of the codebars that causes the received character to be printed.

### 4-14. TAPE READER.

4-15. The tape reader is an electromechanical device that is capable of reading an eight-level coded tape. The characters read are printed by the teleprinter and transmitted by the distributor mechanism to the computer. The reader is controlled by a START/STOP/FREE lever; when enabled, the reader generates a distributor cycle which transmits data to the computer.

### 4-16. TAPE PUNCH.

4-17. The tape punch is an electromechanical device that is capable of punching (storing) data on eight-level tape. The tape punch receives data from the selector mechanism in the printing unit. The selector mechanism sets up the mechanical codebar arrangement at the end of the cycle. The particular arrangement is then sensed by the tape punch sensing pins and transferred to the code punch pins, which perforate the tape. The tape punch is engaged and disengaged by the ON and OFF pushbuttons.

## 4-18. DETAILED CIRCUIT DESCRIPTION.

4-19. There are four major circuits in the teleprinter:

a. Power supply and motor control circuit.
b. Selector magnet driver (SMD) circuit.
c. Distributor circuit.
d. Reader control circuit.

# SECTION V

# MAINTENANCE

## 5-1. INTRODUCTION.

5-2. This section provides preventive maintenance procedures, adjustment information, and troubleshooting information for the teleprinter. A component location photograph (figure 5-20) and parts list (table 5-3) for the reader control card and an overall schematic diagram (figure 5-21) are included in this section.

## 5-3. PREVENTIVE MAINTENANCE.

5-4. Table 5-1 gives step-by-step preventive maintenance procedures for the teleprinter. The procedures should normally be performed once every month or every 100 operating hours, whichever occurs first. When the teleprinter is operated in an extremely dusty environment, the procedures should be performed more frequently.

5-5. Volume I of the Teletype manual provides cleaning solvent recommendations and gives further cleaning and lubricating instructions that should be performed every 750 operating hours or 6 months, whichever occurs first. Lubrication and cleaning supplies are listed in table 6-1.

5-6. Use the teleprinter elapsed time indicator to determine hours of operating time for preventive maintenance purposes. The indicator can be observed by opening the teleprinter cover halfway and looking through the opening above the right side of the cover.

## 5-7. ADJUSTMENTS.

5-8. Volume II of the Teletype manual provides complete adjustment procedures for the teleprinter. Adjustments should be checked when poor performance indicates possible maladjustment.

## 5-9. TROUBLESHOOTING.

5-10. To isolate trouble in the teleprinter, first determine the malfunction. Then locate the malfunction symptom in table 5-2 and perform the steps in the flowchart that is listed opposite the symptom. A parts location diagram of the reader control card (figure 5-20) and an overall schematic diagram (figure 5-21) are provided as troubleshooting aids.

Note

When making any adjustment, check all related adjustments that are listed in the Teletype manual. The nine-digit section numbers on the flowcharts refer to Teletype manual sections; page numbers in parenthesis refer to older Teletype manuals. Part numbers referenced (for example, TTY 181821) are Teletype part numbers and may be found in the replaceable parts section of the Teletype manual.

Table 5-1. Preventive Maintenance Procedures

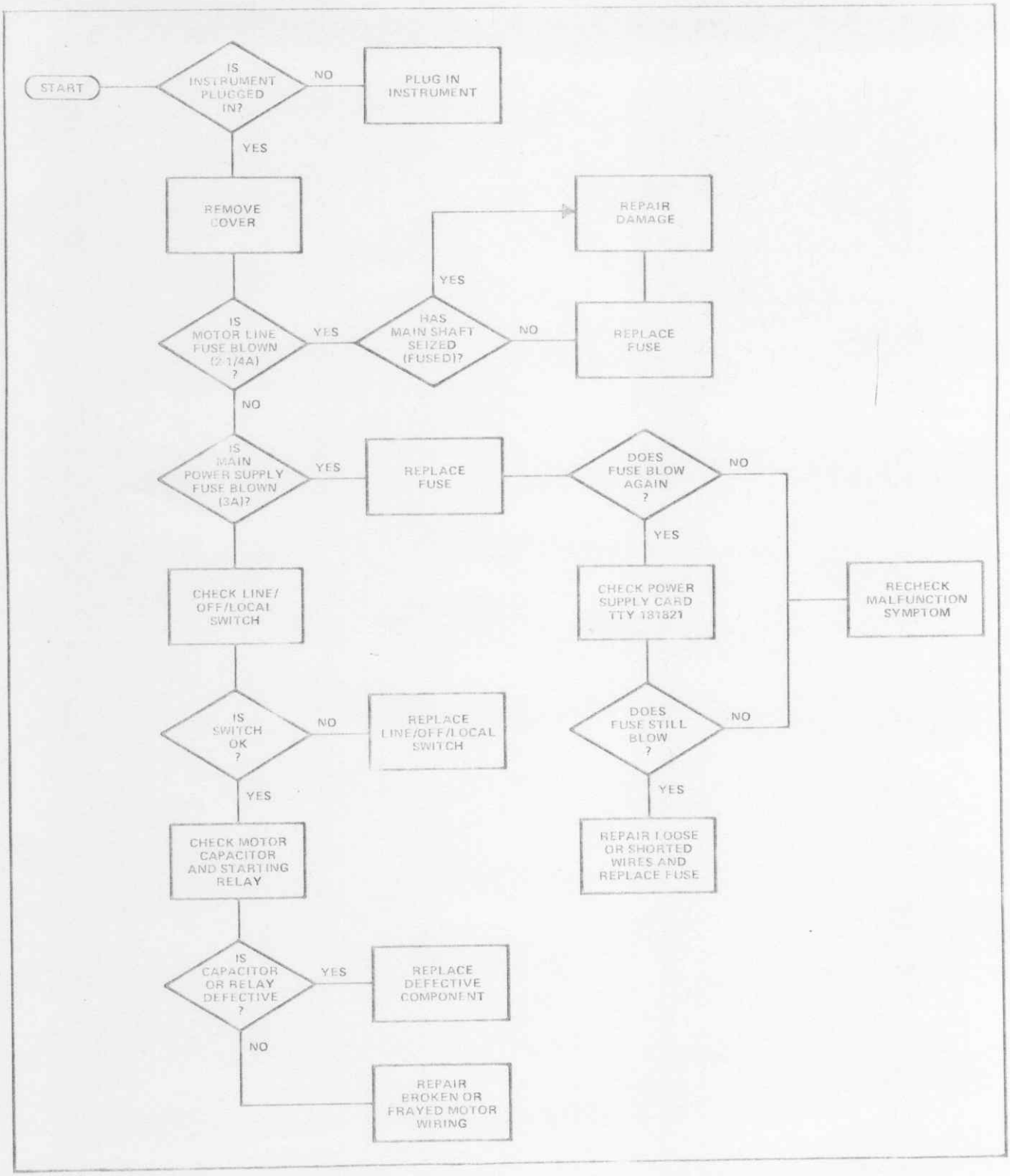
| STEP | INSTRUCTIONS | TELETYPE MANUAL REFERENCE |
|---|---|---|
| 1 | Remove Line/Off/Local switch knob. | |
| 2 | Remove name plate (plate snaps off). | |
| 3 | Remove platen knob. | |
| 4 | Remove the eight screws from the teleprinter cover as follows:<br><br>a. Three thumb screws on rear.<br>b. Four screws under name plate. .<br>c. One screw on tape reader. | Figure 1, Page 2, Section 574-100-201 |
| 5 | Remove ribbon from teleprinter. | Figure 5, Page 10 |
| 6 | Remove type wheel (held in place by one 3/16 in. nut). | |
| 7 | Clean type wheel in solvent and inspect for worn or damaged letters and numbers. | |
| 8 | Remove print hammer head and clean with solvent. Inspect head for wear. | |
| 9 | CAUTION<br><br>Do not saturate the carriage assembly with solvent or damage to the assembly may result. Clean carriage assembly of all ink. | |
| 10 | Reinstall print hammer head. | |
| 11 | Clean platen with solvent. | |
| 12 | Clean paper guide with solvent. | |
| 13 | Clean dashpot piston with solvent. | |
| 14 | Lubricate dashpot piston with a light coat of oil. | |
| 15 | Clean inside of dash pot cylinder with solvent. | |
| 16 | Clean all associated parts of piston and dash pot cylinder with solvent. | |
| 17 | Remove the four screws that hold drive motor in place. | Figure 7, Page 10, Section 574-122-702 |
| 18 | Remove retaining ring that holds pulley gear in place. | |
| 19 | Remove pulley gear. | |
| 20 | Clean pulley gear with solvent. | |
| 21 | Lubricate hollow space inside pulley gear with grease. | |

Table 5-1. Preventive Maintenance Procedures (Continued)

| STEP | INSTRUCTIONS | TELETYPE MANUAL REFERENCE |
|---|---|---|
| 22 | Inspect pinion gear for wear and cracks. | |
| 23 | Install pulley gear and retaining ring on motor. | |
| 24 | Inspect pulley gear and pinion gear for proper mesh. | |
| 25 | Remove fan from motor. Fan is held in place by an 8/32 in. allen screw. | |
| 26 | Clean fan with solvent and inspect for cracks. Install fan on motor. | |
| 27 | Lubricate the two oil holes on motor with three drops of oil each. | Page 17, Section 574-122-701 |
| 28 | Clean the main shaft mechanism of all dust and dirt. Use a cotton swab saturated with solvent. | Figure 7, Page 10, Section 574-122-702 |
| 29 | Inspect main shaft for lateral movement. | |
| 30 | Inspect drive shaft bearings for wear. Lubricate main shaft mechanism with two drops of oil where each part intersects with main shaft. | |
| | CAUTION | |
| | Be sure to hook up ground wire in following step or damage to the motor may result. | |
| 31 | Install drive motor. | Figure 7, Page 10, Section 574-122-702 |
| 32 | Inspect drive belt for proper tension. | |
| 33 | Refer to Teletype manual for complete lubrication instructions for the keyboard. | Page 1, Section 574-121-701 |
| 34 | Refer to Teletype manual for complete lubrication instructions for the typing unit. | Page 1, Section 574-122-701 |
| 35 | Clean the entire reader unit with a soft brush to remove all paper dust. | |
| 36 | Lubricate reader. | Page 1, Section 574-124-701 |
| 37 | Clean the tape punch with a soft brush. | |
| 38 | Remove the chad chute extension and clean. Reinstall chad chute extension. | |
| 39 | Lubricate the tape punch. | Page 1, Section 574-125-701 |

Table 5-2. Troubleshooting Flowchart Selection

| MALFUNCTION SYMPTOM | TROUBLESHOOTING FLOWCHART |
|---|---|
| Unit dead with switch set to LOCAL. | Figure 5-1 |
| Key will not return. | Figure 5-2 |
| Double line spacing. | Figure 5-3 |
| Unit will not produce any functions. | Figure 5-4 |
| No carriage return. | Figure 5-5 |
| Noisy motor. | Figure 5-6 |
| Double printing. | Figure 5-7 |
| No line feed. | Figure 5-8 |
| Cannot print or punch from keyboard. | Figure 5-9 |
| Prints improper symbols. | Figure 5-10 |
| Runs open (LOCAL position) with selector open. | Figure 5-11 |
| Runs open (LOCAL position) with selector closed. | Figure 5-12 |
| Runs open (LOCAL position) with reader on. | Figure 5-13 |
| Tape reader advances tape incorrectly. | Figure 5-14 |
| Prints when function is selected. | Figure 5-15 |
| Tape reader reading improperly. | Figure 5-16 |
| No spacing at left margin. | Figure 5-17 |
| No spacing. | Figure 5-18 |
| Tape reader will not read. | Figure 5-19 |




2089-2

Figure 5-1. Troubleshooting Flowchart, Unit Dead with Switch Set to LOCAL

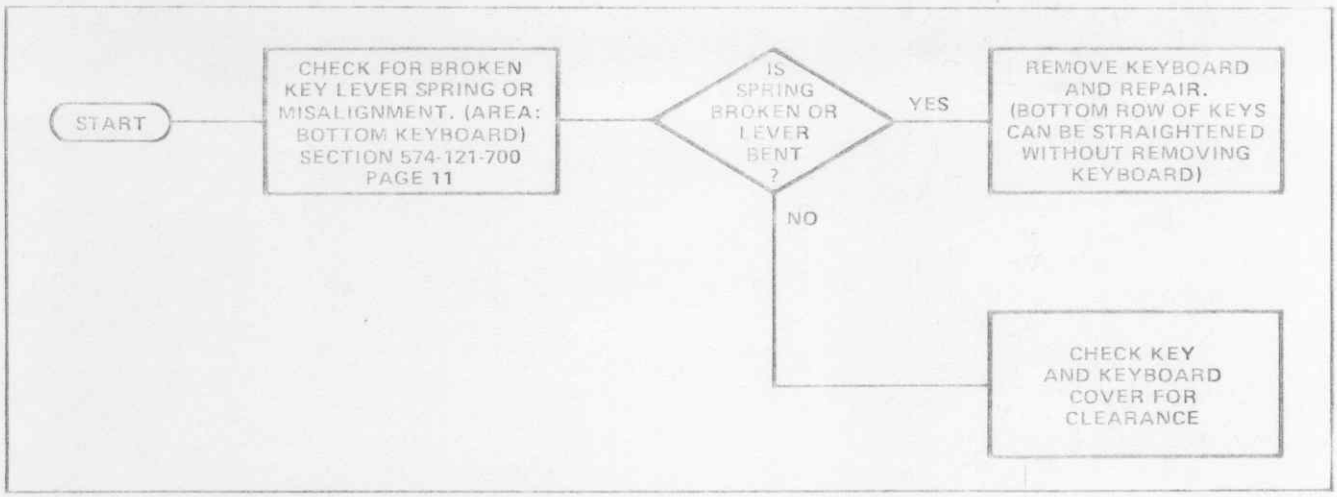



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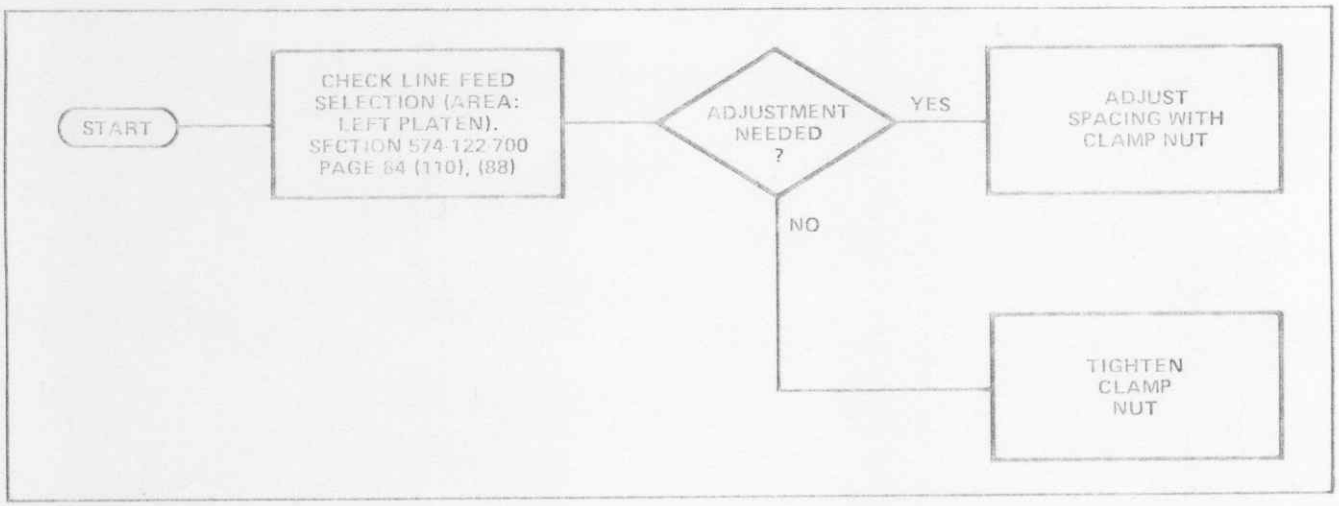
Figure 5-2. Troubleshooting Flowchart, Key Will Not Return




2089-5

Figure 5-3. Troubleshooting Flowchart, Double Line Spacing

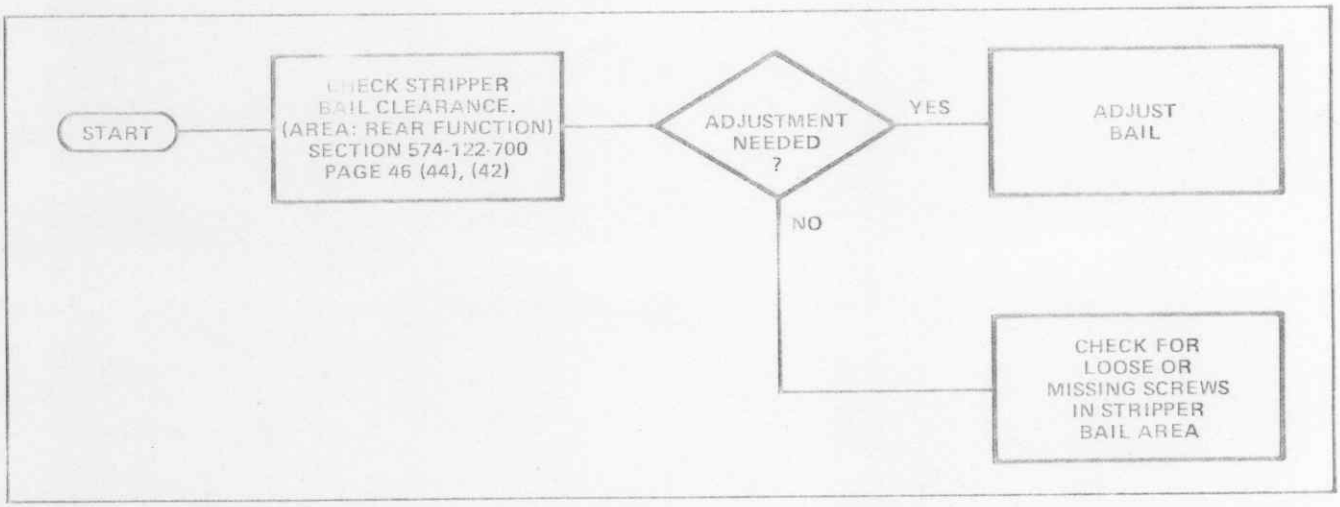



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Figure 5-4. Troubleshooting Flowchart, Unit Will Not Produce Any Functions

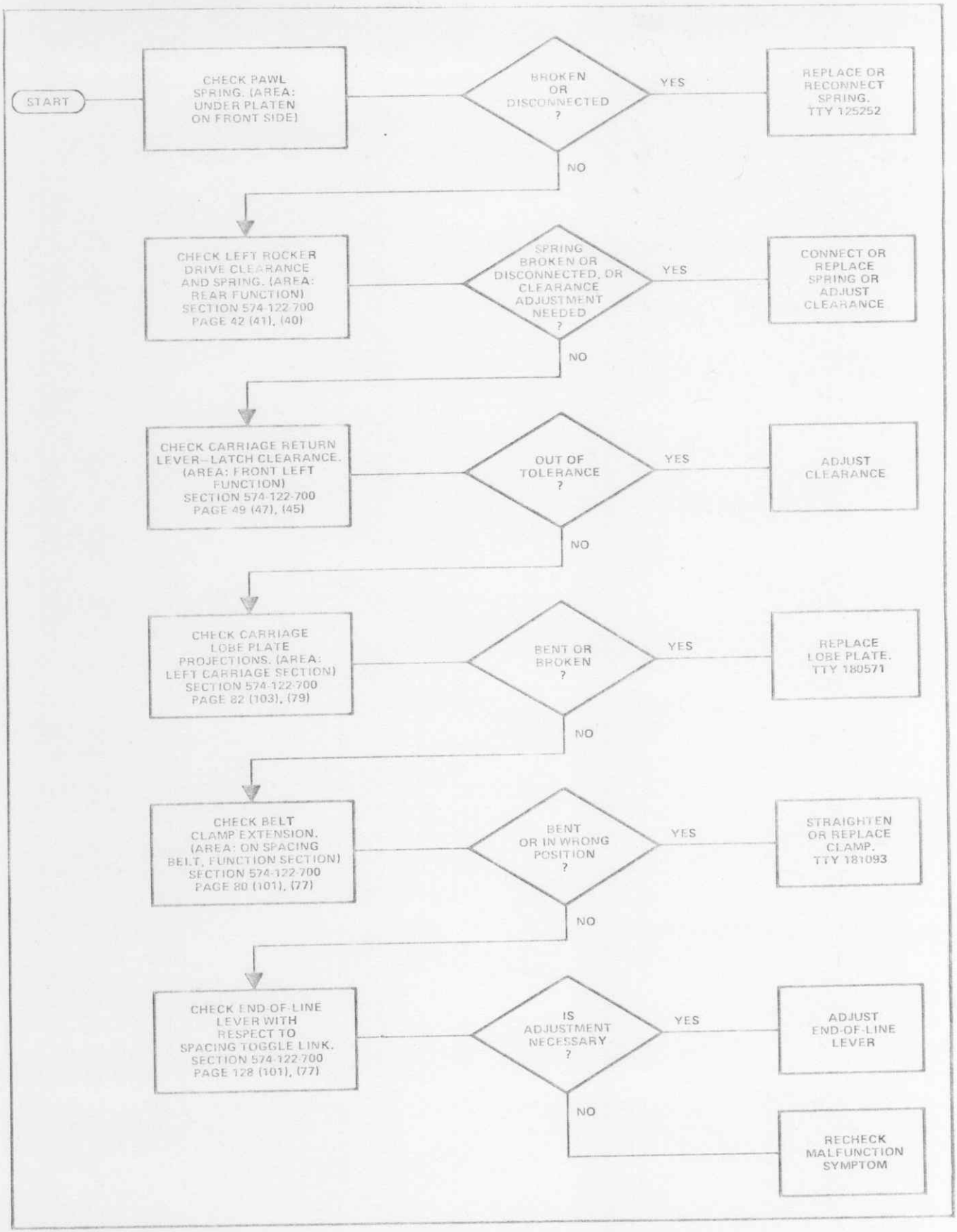


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Figure 5-5. Troubleshooting Flowchart, No Carriage Return

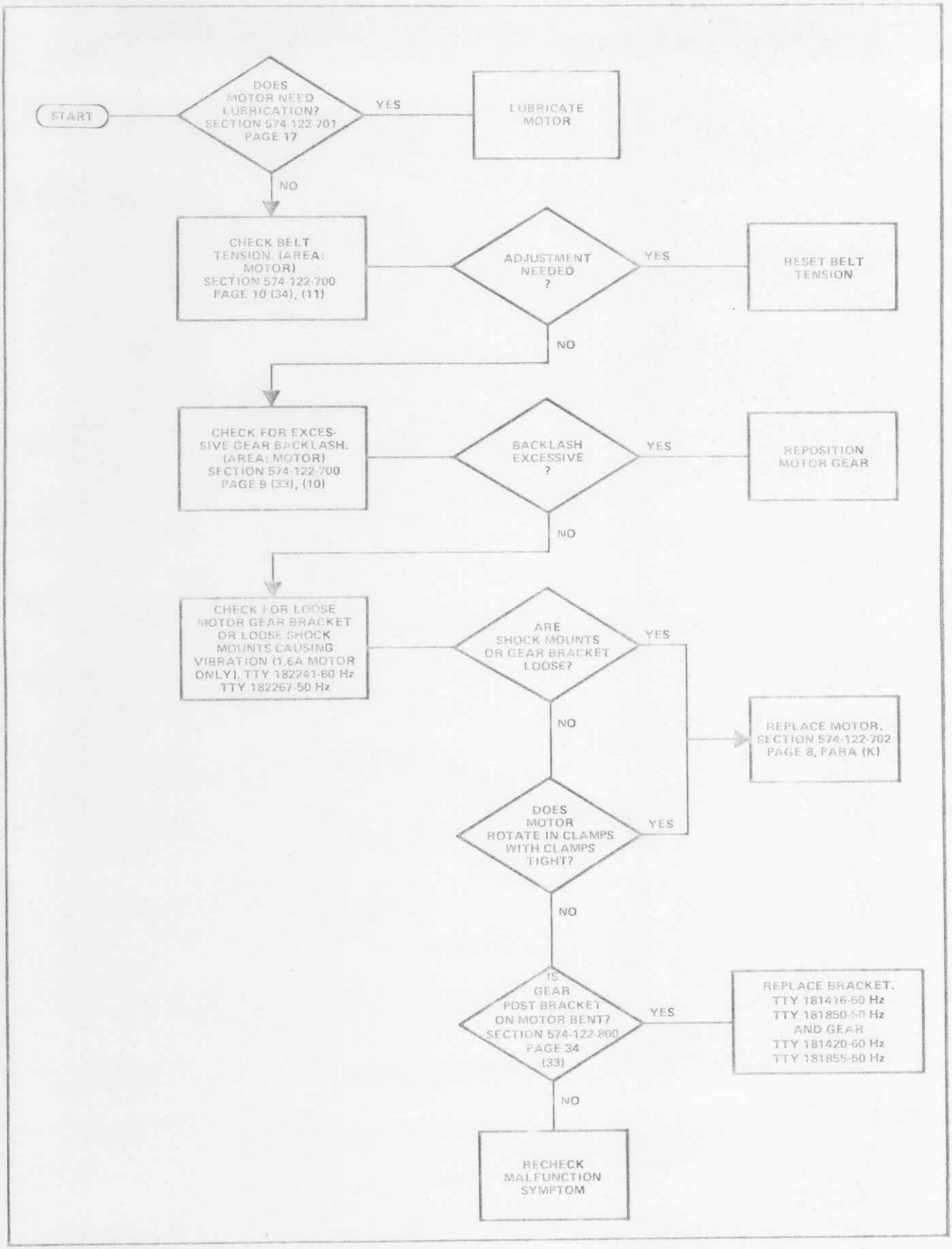


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Figure 5-6. Troubleshooting Flowchart, Noisy Motor

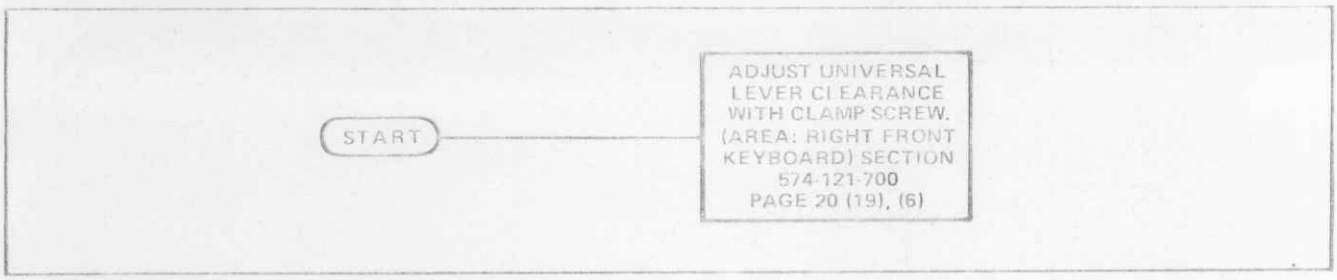


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Figure 5-7. Troubleshooting Flowchart, Double Printing

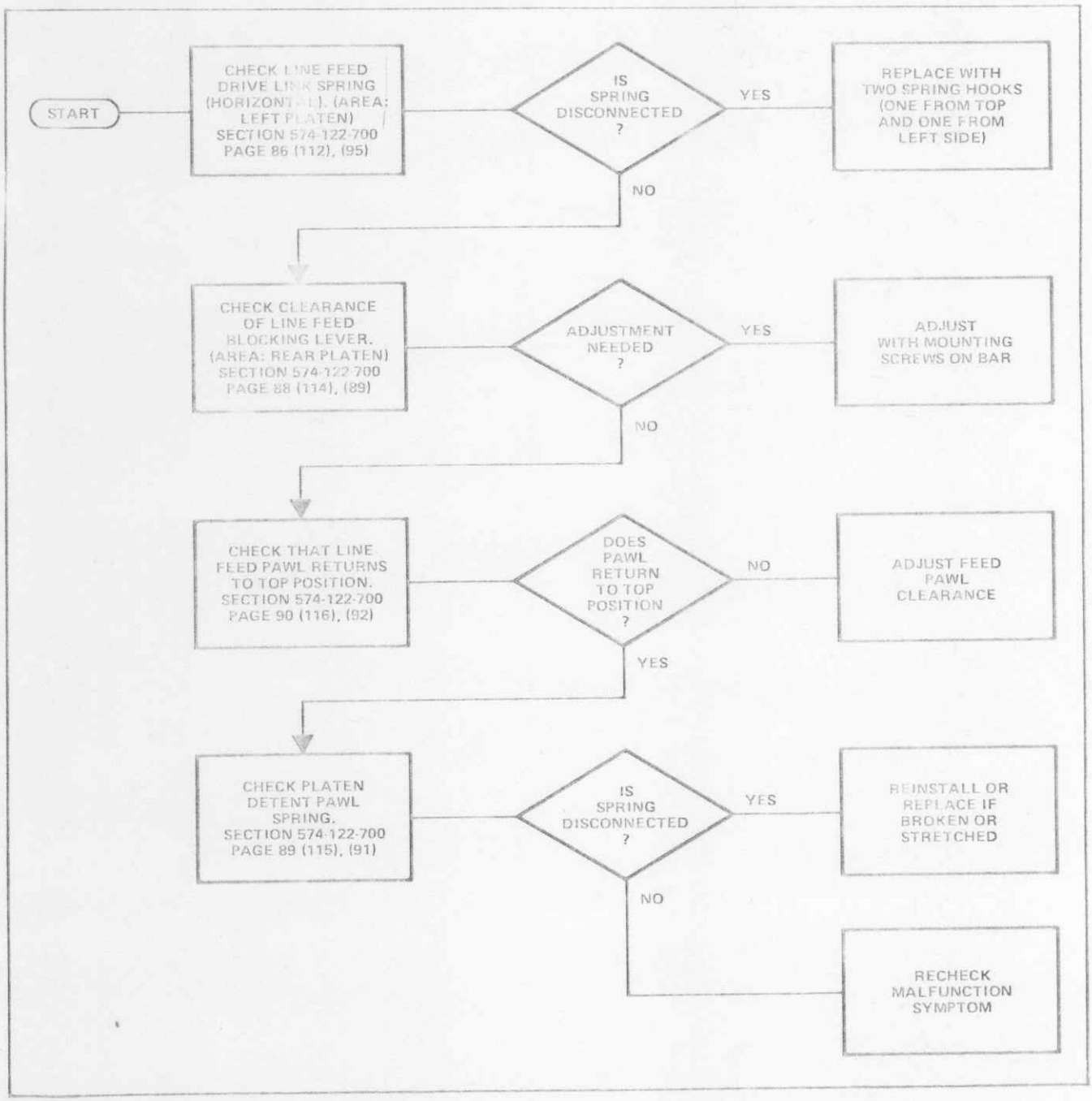


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Figure 5-8. Troubleshooting Flowchart, No Line Feed

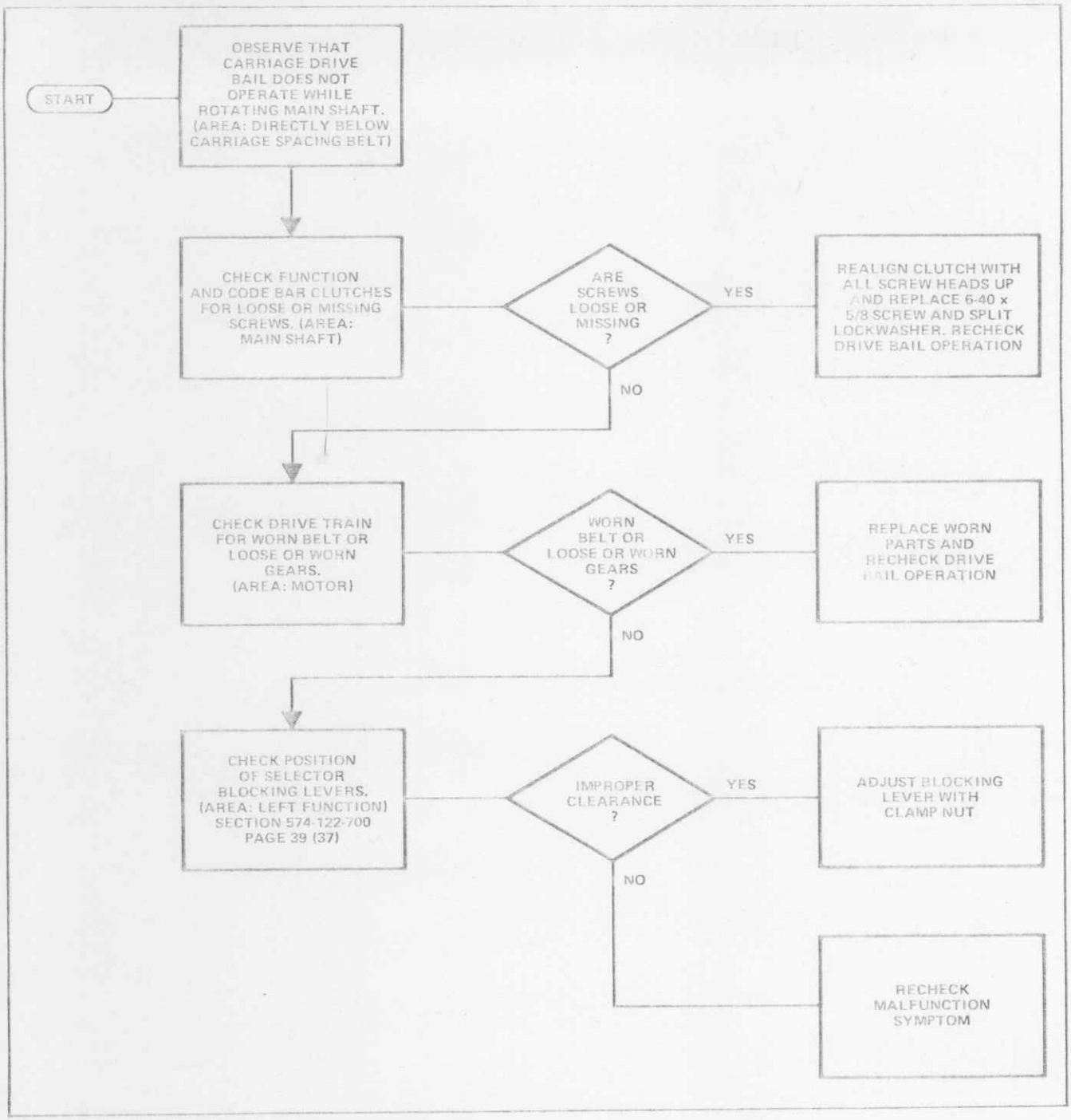


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Figure 5-9. Troubleshooting Flowchart, Cannot Print or Punch from Keyboard

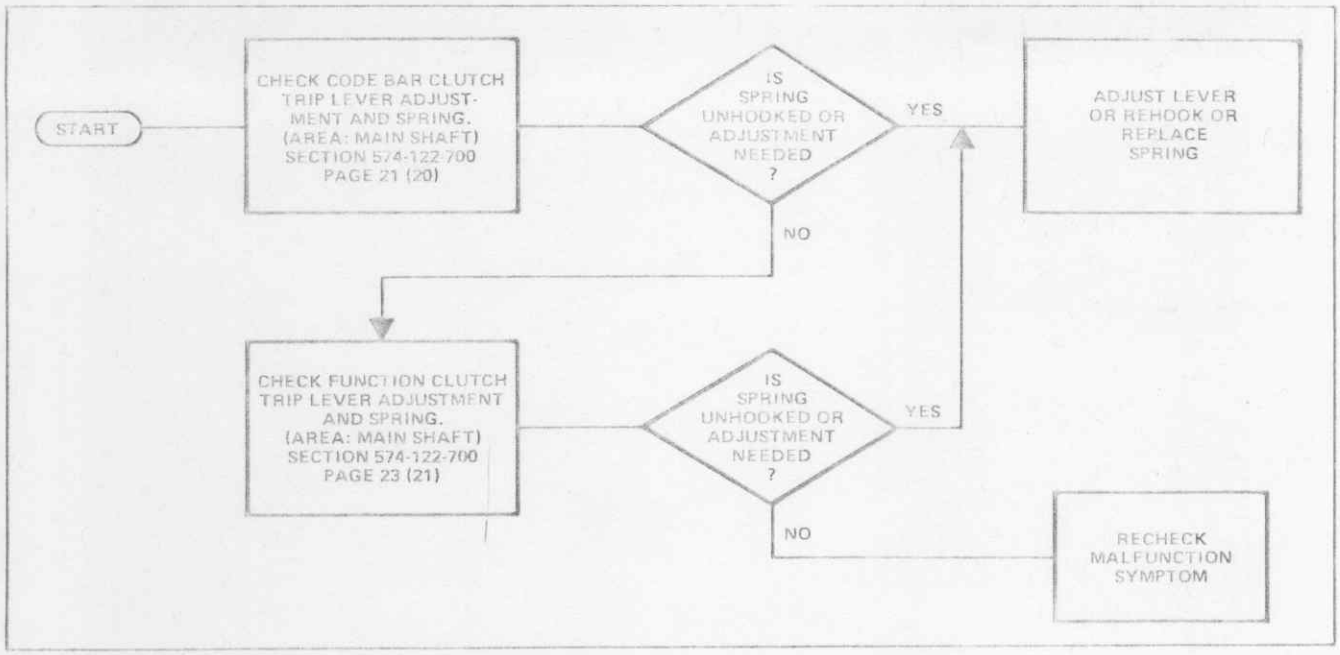


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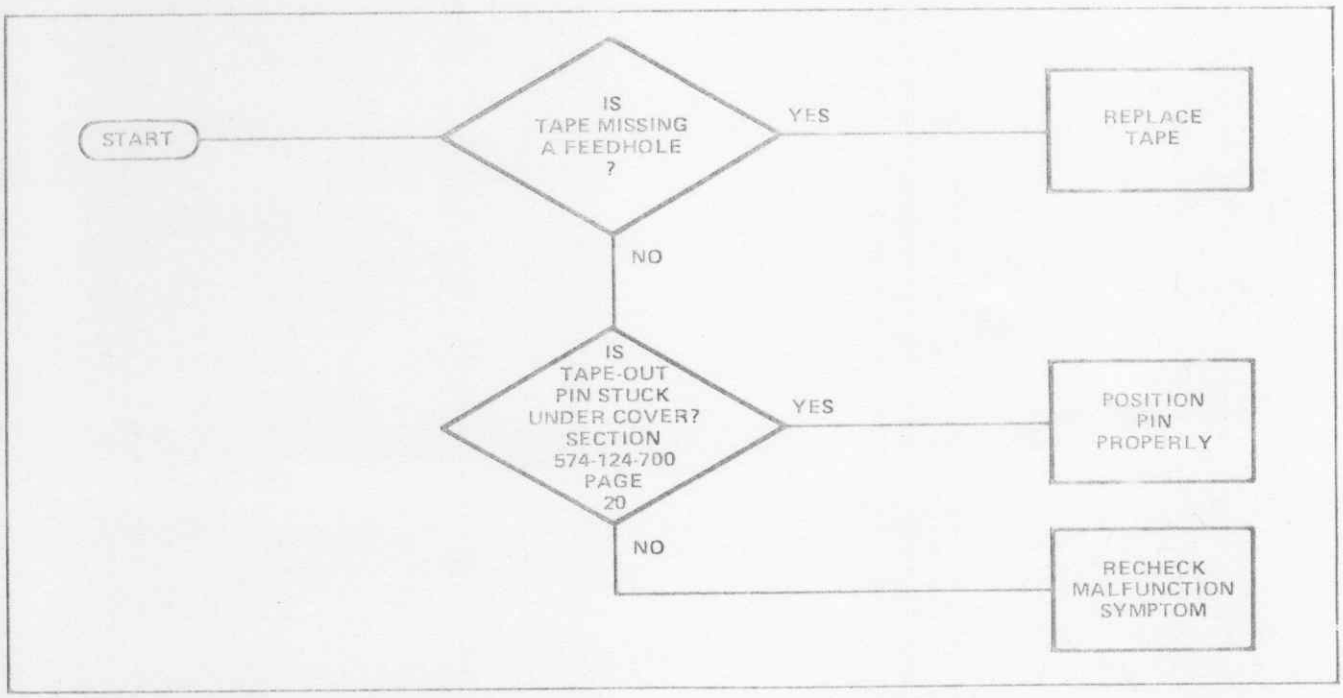
Figure 5-12. Troubleshooting Flowchart, Runs Open (LOCAL Position) with Selector Closed




2089-17

Figure 5-13. Troubleshooting Flowchart, Runs Open (LOCAL Position) with Reader On

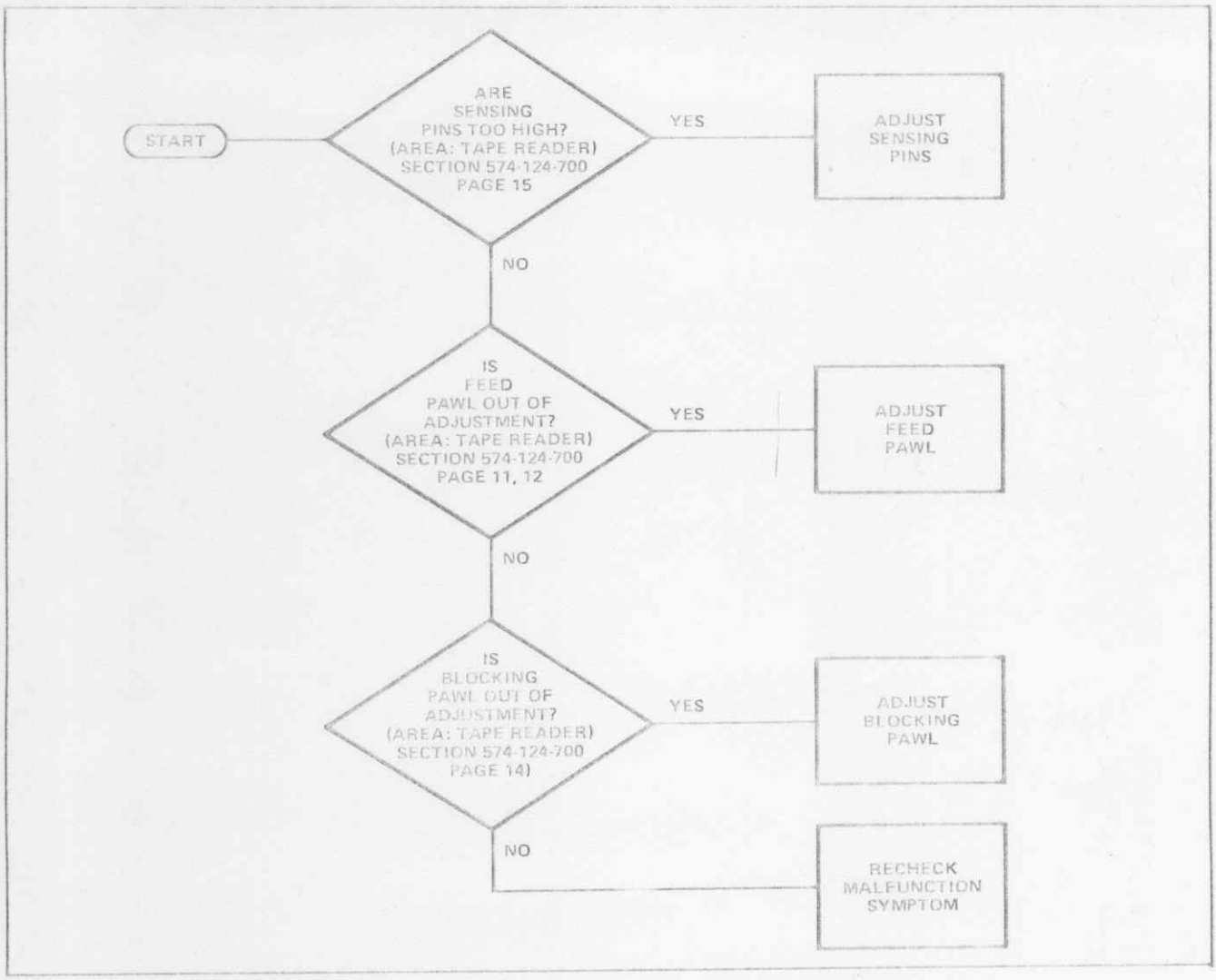



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Figure 5-14. Tape Reader Advances Tape Incorrectly

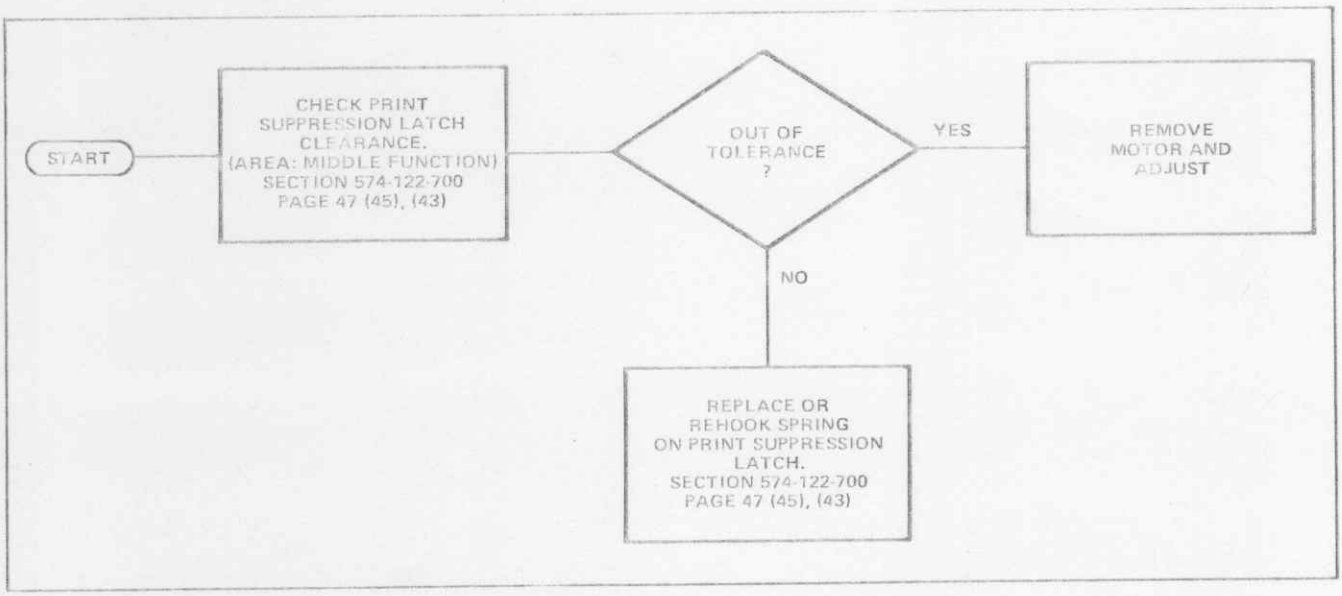


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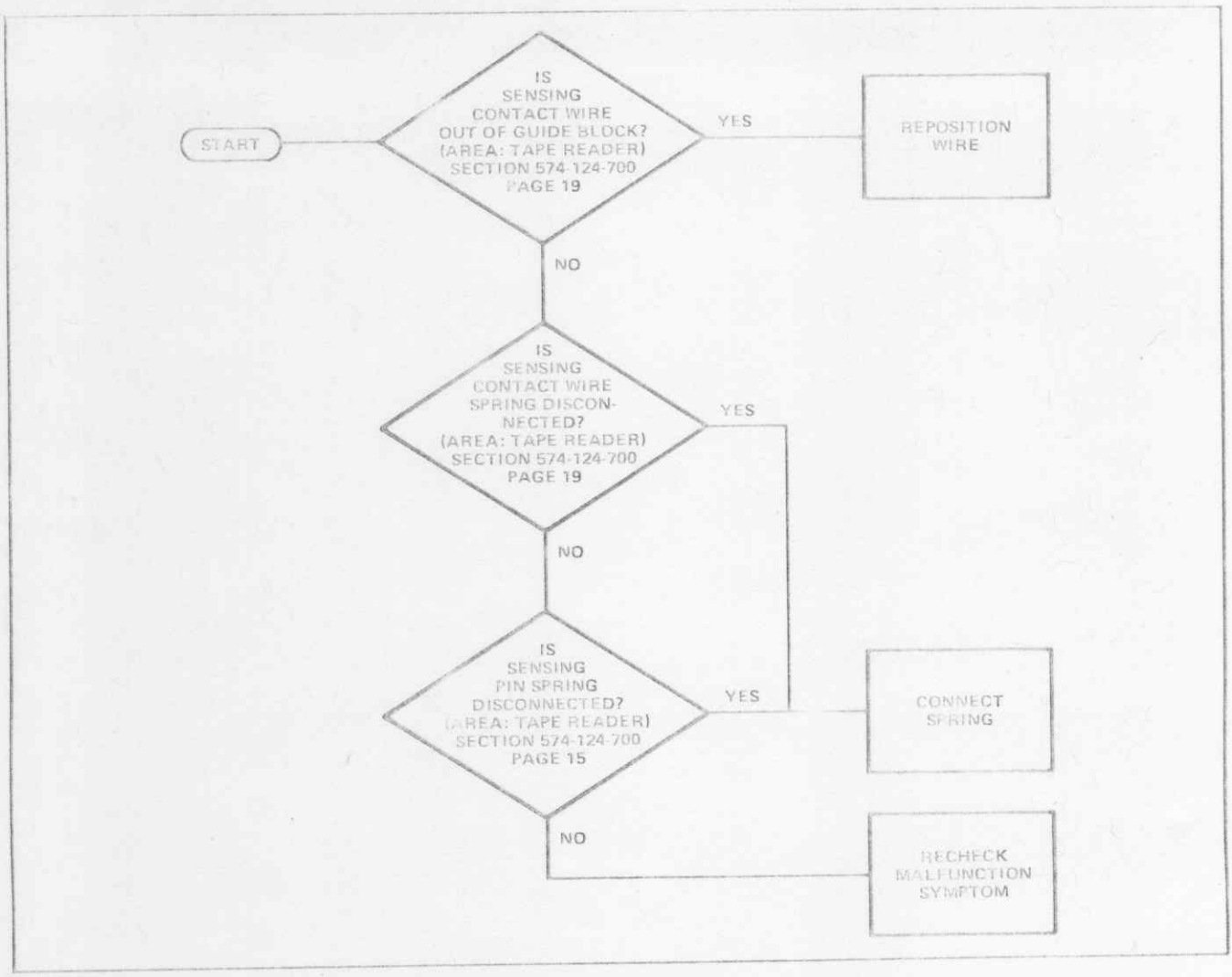
Figure 5-15. Troubleshooting Flowchart, Prints when Function Is Selected




2089-18

Figure 5-16. Troubleshooting Flowchart, Tape Reader Reading Improperly

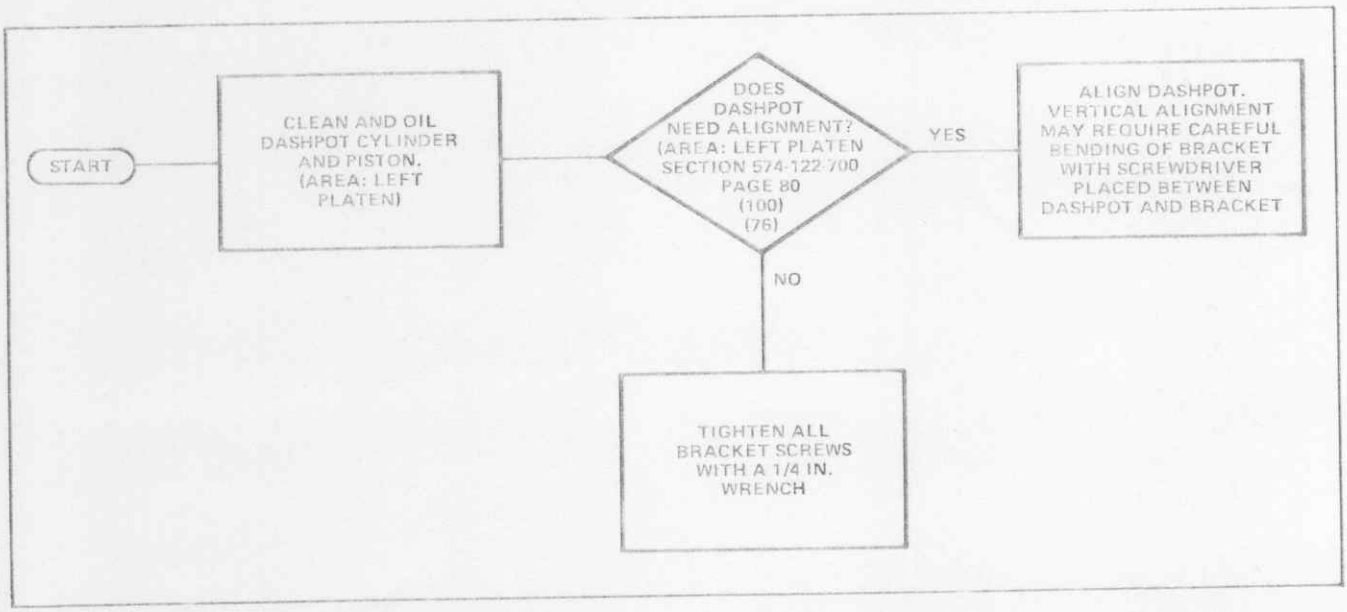



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Figure 5-17. Troubleshooting Flowchart, No Spacing at Left Margin

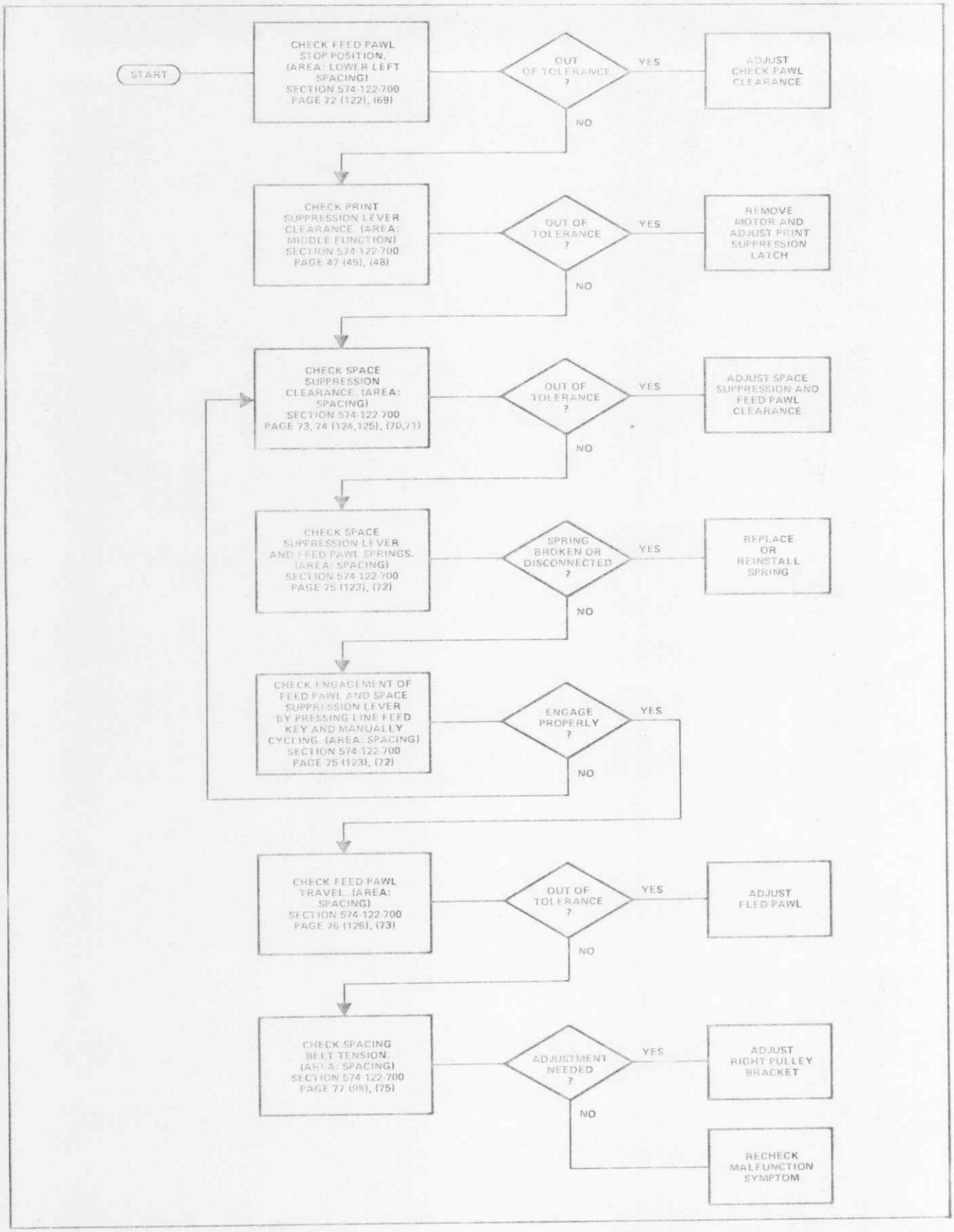


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Figure 5-18. Troubleshooting Flowchart, No Spacing

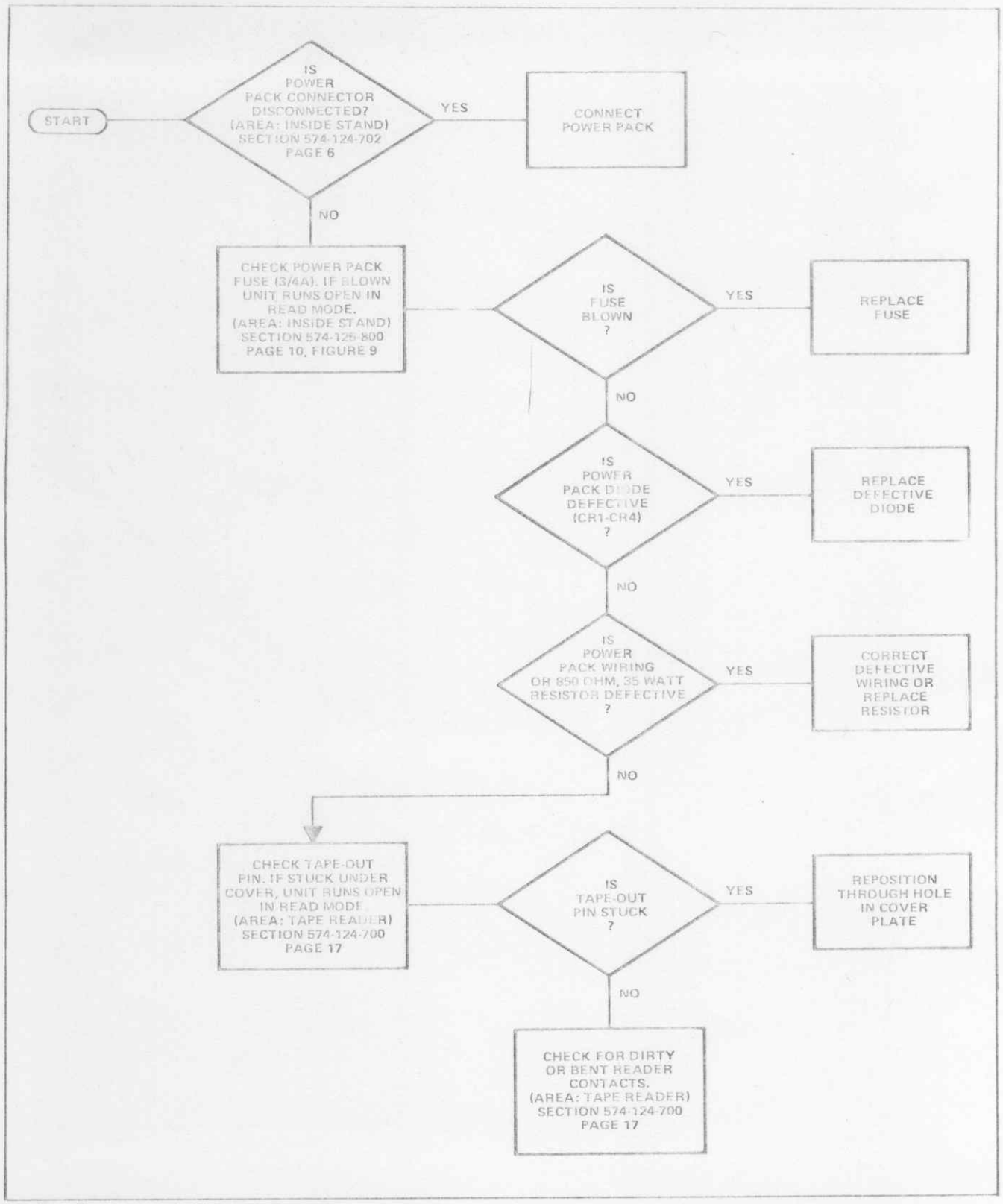


Figure 5-19. Troubleshooting Flowchart, Tape Reader Will Not Read

HEWLETT hp PACKARD

# OPERATING AND SERVICE MANUAL

# 12531C

## BUFFERED TELEPRINTER INTERFACE KIT

(FOR 2100, 2114, 2115, AND 2116 COMPUTERS)

Card Assembly
12531-60022, Rev. 1117 and 1120

12531-90033

HEWLETT-PACKARD COMPANY
11000 WOLFE ROAD, CUPERTINO, CALIFORNIA, U.S.A.

Printed: JULY 1971

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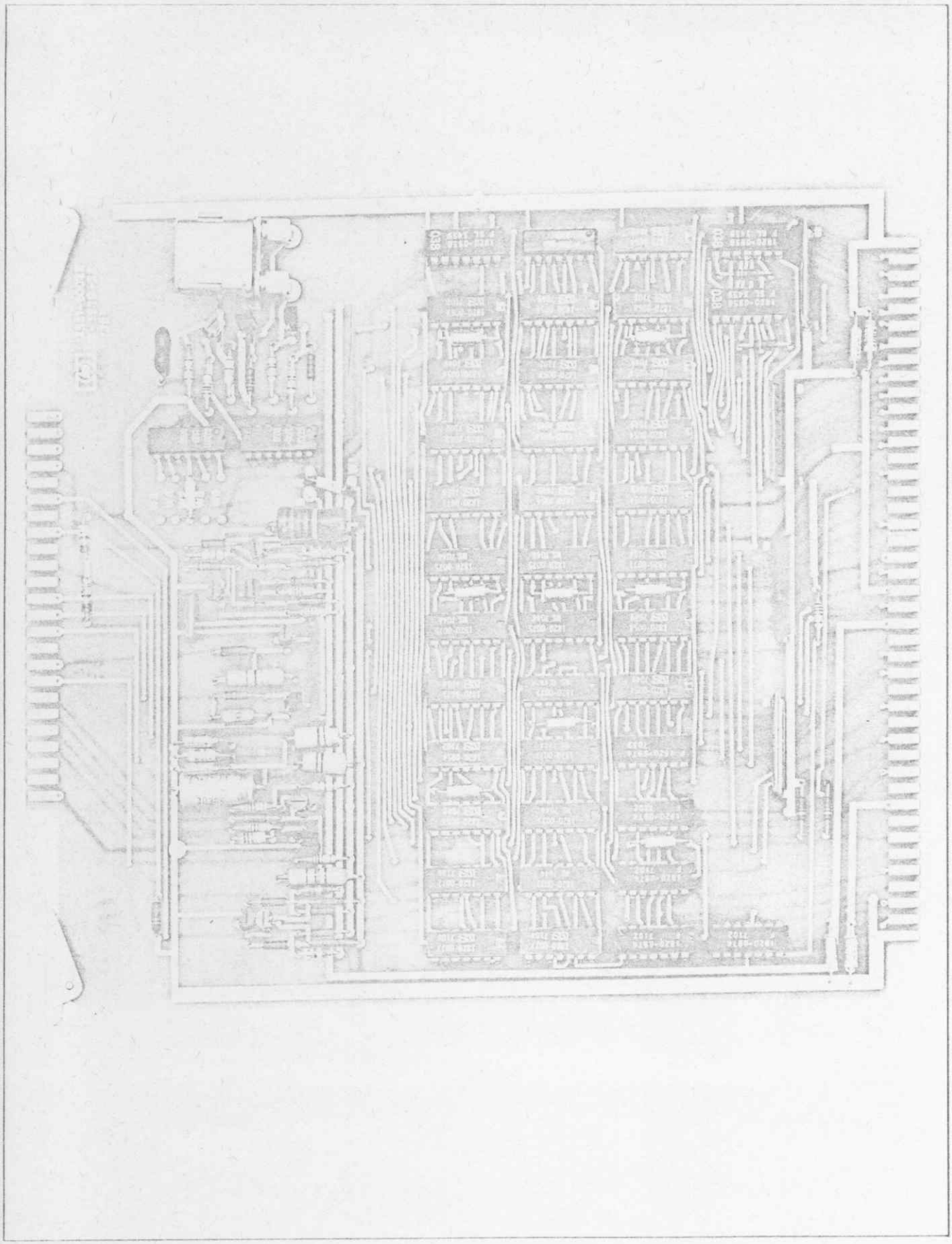


Figure 1-1. 12531C Buffered Teleprinter Interface Card

# SECTION I

# GENERAL INFORMATION

## 1-1. INTRODUCTION.

1-2. This manual provides general information, installation and programming instructions, theory of operation, maintenance instructions, troubleshooting information, and replaceable parts information for the Hewlett-Packard (HP) 12531C Buffered Teleprinter Interface Kit.

## 1-3. DESCRIPTION.

### 1-4. GENERAL.

1-5. The circuit card in the interface kit controls data transfer between an HP computer and an HP 2752A or 2754B Teleprinter. In this manual, the term "teleprinter" signifies either of these two teleprinter models. The terms "circuit card", "interface card", or "card" indicate the circuit card supplied in the kit.

1-6. As well as being used with the above teleprinters, interface kit options 001 and 002 allow the interface kit to be used with Electronic Industries Association (EIA) compatible devices. Option 001 is used with devices such as the HP 2749A Teleprinter or HP 2600A Keyboard-Display Terminal. Option 002 is used with data modems such as the Bell model 103A Data-Phone. A jumper wire on the card allows the selection of five different rates of data transfer to permit use of the card with various I/O devices. A second jumper wire on the card can be connected to allow an external clock pulse, supplied by the I/O device, to control the rate of data transfer.

1-7. The interface card installs in the computer cabinet or in the cabinet of an I/O extender, and can be used with the HP 2100, 2114, 2115, or 2116 Computer.

### 1-8. KIT CONTENTS.

1-9. The 12531C Buffered Teleprinter Interface kit contains one each of the following:

a. Buffered teleprinter interface card (part no. 12531-60022), illustrated in figure 1-1.

b. Operating and service manual (part no. 12531-90033).

### 1-10. IDENTIFICATION FEATURES OF KIT AND CONTENTS.

1-11. KIT. Five digits and a letter (00000A) are used to identify standard interface kits used with HP computers. The five digits identify the kit; the letter indicates the revision level of the kit.

1-12. CIRCUIT CARD. The circuit card supplied with the kit is identified by a part number marked on the card. In addition to a part number, the card is further identified by a letter, a revision code, and a division code (e.g., B-1117-22). This designation is placed below the part number. The letter identifies the version of the etched circuit on the card. The revision code (the four digits following the letter) identifies the electrical characteristics of the card with components mounted. The division code (one or two digits) identifies the HP division which manufactured the card.

1-13. This manual deals with two versions of the buffered teleprinter interface card. The revision codes for these cards are 1117 and 1120. The difference between the cards is that resistors R32 and R33 are changed in value. If a circuit card has part number 12531-60022 but a revision code other than 1117 or 1120, this manual will not apply. The appropriate manual or supplement can be ordered from the nearest HP Sales and Service Office. These offices are listed at the back of this manual.

1-14. OPERATING AND SERVICE MANUAL. The manual supplied with the kit is identified by its name and part number. The part number, 12531-90033, is printed in the lower left corner of the manual cover. The publication date is printed in the lower right corner. If the manual is revised, the publication date on the cover is changed.

## 1-15. SPECIFICATIONS.

1-16. Table 1-1 lists the specifications of the 12531C Buffered Teleprinter Interface Kit. In the table and throughout this manual the term "character" signifies an 8-bit, 10-bit, or 11-bit word handled by the interface card. In the case of data sent to the printer portion of the teleprinter, each character results in the typing of a letter of the alphabet, a digit, or a symbol, or the character causes actuation of such typewriter mechanical functions as carriage return or a bell stroke. When a character is sent to the punch portion of the teleprinter, the eight data bits involved are punched in the tape. When receiving data from the teleprinter keyboard, a character is supplied each time a key is pressed. When a character is furnished by the teleprinter tape reader, a character is received for each set of holes read in the tape.

Table 1-1. Specifications

| ITEM | SPECIFICATIONS |
|---|---|
| Character code, computer output*: | |
| Teleprinter tape punch | Any 8-bit character. |
| Teleprinter print unit | Eight-bit ASCII code (including parity bit), modified for HP use. |
| I/O devices other than teleprinter | Any 8-bit character the I/O device is capable of accepting. |
| Character code, computer input**: | |
| Teleprinter tape reader | Any 8-bit character. |
| Teleprinter keyboard | Eight-bit ASCII code, modified for HP use, with even parity. Early models of the 2752A Teleprinter did not have the parity feature; the parity bit is logic 0 if not used. |
| I/O devices other than teleprinter | Any 8-bit character the I/O device is capable of furnishing. |
| Parity Check: | When the I/O device is the teleprinter, no parity check is made by the hardware. If desired, a parity check of inputs from the teleprinter keyboard or teleprinter tape reader can be made by the software. |
| Data transfer rate: | |
| Using internal clock pulse | Data transfer rate is 110, 220, 440, 880, or 1760 bits per second, depending on whether jumper W2, W3, W4, W5, or W6 is installed on the interface card. For the teleprinter, W2 is used and the transfer rate, in terms of characters, is 10 characters per second for the teleprinter tape reader unit. For keyboard operations, character transfer rate is determined by the speed of typing. For the teleprinter print and punch units, character transfer rate is determined by the computer program, and must not exceed 10 characters per second. |
| Using external clock pulse | For computer input, maximum character transfer rate is 1/80th of the clock pulse frequency. For computer output, maximum rate is 1/88th of the clock pulse frequency. These rates decrease if characters are supplied at a slower rate by the I/O device or computer. |
| Voltage levels: | |
| Signal level, interface card to Bell Model 103A Data-Phone | Logic 1, -3 to -20V dc<br>Logic 0, +3 to +20V dc |
| Signal level, Bell Model 103A Data-Phone to interface card | Logic 1, -11 to -13V dc<br>Logic 0, +11 to +13V dc |
| Current required from computer by interface card† | |
| +4.5V dc | 0.76A |
| -3V dc | 0.05A |
| +12V dc | 0.05A |
| -12V dc | 0.10A |

* In a computer output operation, 8-bit characters are transferred in parallel from the computer to the interface card. There, one start bit and one or two stop bits are added, and the resulting 10 or 11 bits are transferred in serial to the teleprinter.

** In a computer input operation, 11-bit or 10-bit characters are transferred serially from the I/O device to the interface card. There, a start bit, and one or two stop bits are discarded. The resulting 8-bit word is transferred in parallel to the computer A- or B-register.

† Includes +12-volt and -12-volt current from the interface card to the teleprinter.

# SECTION II

# INSTALLATION

## 2-1. INTRODUCTION.

2-2. This section provides information on unpacking, inspecting, installing, and checking the operation of the interface kit.

## 2-3. UNPACKING AND INSPECTION.

2-4. If the interface kit is ordered with a computer, the kit is installed at the factory. When this is the case, it is necessary only to check operation of the teleprinter, together with the interface card, after the computer and teleprinter are installed. Checkout instructions are furnished in paragraph 2-17.

2-5. If the interface kit is ordered separately, inspect the carton containing the kit before opening it. If there is evidence of damage, if water stains are visible, or if the box rattles, request that the carrier's agent be present when the box is opened.

2-6. Inspect each portion of the kit as the parts are unpacked. Look for such damage as cracks, dents, broken components, detached parts, corrosion, water damage, etc. If any part of the kit is damaged, retain the carton, packing material, and shipping papers, and immediately notify the carrier and the nearest Hewlett-Packard Sales and Service Office. The Sales and Service Office will arrange for repair or replacement of damaged parts without waiting for settlement of claims against the carrier. (HP Sales and Service Offices are listed at the back of this manual.)

2-7. After inspecting all components, refer to paragraph 1-9 of this manual and ensure that the kit is complete. Also check the part numbers given in paragraph 1-9 against the part numbers on the kit components. If the kit is incomplete, or if an incorrect component has been furnished, notify the nearest Hewlett-Packard Sales and Service Office.

## 2-8. PREPARATION FOR INSTALLATION.

### 2-9. COMPUTATION OF CURRENT REQUIREMENTS.

2-10. The circuit card in the interface kit obtains its operating voltages from the computer power supply. Before installing the card, it is necessary to determine whether the added current will overload the power supply. (If the circuit card was installed at the factory, the required calculations have been made, and it has been determined that overload will not occur.) The current requirements of the interface card are listed in table 1-1. Included is the +12- and -12-volt current forwarded from the interface card to the teleprinter.

2-11. If current requirements exceed the capabilities of the computer power supply, an HP power supply extender or I/O extender must be installed.

### 2-12. JUMPER WIRE CONNECTIONS.

2-13. The interface card has two jumper wires, which are shown in figure 5-2. If the card is supplied as part of a computer system, the jumper wires are connected to suit the I/O device with which the card is used. If the card is not supplied as part of a computer system, the jumpers are connected for use with a teleprinter. For the teleprinter, one jumper is used in position W1, and is connected to terminal A, to permit the clock pulse generated on the interface card to be employed. The other jumper is connected in position W2 to select a data transfer rate of 110 bits per second, which is required for the teleprinter.

2-14. If the circuit card is used with an I/O device other than the teleprinter, and the card is not received in a computer, the two jumpers must be connected to suit the device. If the I/O device furnishes a clock pulse to the interface card, the jumper used in position W1 is connected to terminal B, rather than terminal A. If the clock on the interface card is to be used, jumper W1 must be connected to terminal A and the other jumper is connected in position W2, W3, W4, W5, or W6, to select respectively 110, 220, 440, 880, or 1760 bits per second, to suit the data transfer rate of the I/O device.

## 2-15. INSTALLATION.

2-16. After ensuring that the computer power supply can handle the added load, and after the two jumper wires are correctly connected, install the circuit card in the following manner:

a. Install the computer and teleprinter or other I/O device, if these have not been installed.

b. Determine the I/O select code to be used for the teleprinter or other I/O device, and the I/O interface card slot to which the select code corresponds.

c. Turn off power at the computer and I/O device. Install the circuit card in the required card slot in the computer I/O extender. Components on the card must be on the same side of the card as for other cards in the I/O interface slots. When inserting, exercise care not to damage components or traces on the card or on adjacent cards. Press the circuit card firmly into place.

d. The I/O device has a cable with a connector which fits on the end of the interface card. Pass the cable into the computer or I/O extender and plug the connector on the end of the interface card.

## 2-17. CHECKOUT.

2-18. To verify operation of the interface card, perform the on-line diagnostic test for the I/O device connected to the card. Operating procedures for diagnostic tests are described in the *Manual of Diagnostics*. If the interface card is used with a teleprinter and a 2116-series computer, use procedure part number 5951-1368. For a teleprinter and a 2114- or 2115-series computer, use procedure part number 5951-1367. For a teleprinter and a 2100-series computer, use procedure part number 5951-1365.

## 2-19. RESHIPMENT.

2-20. If an item of the kit is to be shipped to Hewlett-Packard for repair, attach a tag to the item identifying the owner and indicating the service to be performed. Include the interface kit number.

2-21. Pack the item in the original factory packing material. If the original material is not available, standard factory packing material can be obtained from the nearest HP Sales and Service Office.

2-22. If standard packing material is not used, wrap the item in Air Cap TH-240 cushioning (manufactured by Sealed Air Corporation, Hawthorn, N.J.) or equivalent and place in a corrugated carton (200-pound test material). Seal the shipping carton securely and mark it "FRAGILE" to ensure careful handling. Refer any questions to the nearest Hewlett-Packard Sales and Service Office.

# SECTION III

# PROGRAMMING

## 3-1. INTRODUCTION.

3-2. This section describes assembly-language programming procedures for the 12531C interface card and its associated I/O device. It should be noted that in many instances I/O routines in the HP program library can be used in place of specially written routines. Information on the library routines is provided in the Hewlett-Packard Program Catalog (part no. 5950-9226).

3-3. The programming discussion which follows deals with the teleprinter. The explanation also applies to other I/O devices used with the 12531C interface card, except that timing considerations may differ, and the selection of printing or punching by programming means may not apply.

## 3-4. CHARACTER CODES.

3-5. Teleprinter data is transferred to or from the computer A- or B-register. The data is in the form of 8-bit characters which are placed in, or acquired from, positions 7 through 0 of the register. When punching or reading tape in the teleprinter, these characters can be any 8-bit word. When characters are furnished by the teleprinter keyboard, the character code is modified ASCII (American Standard Code for Information Interchange), with even parity. The parity bit is placed in position 7 of the A- or B-register. (The early version of the 2752A Teleprinter did not have the parity feature. The parity bit is logic 0 if not used.) Characters transferred to the print unit of the teleprinter must use the modified ASCII code.

## 3-6. TIMING.

3-7. Approximately 0.1 second is required to transfer a character to or from the teleprinter. This period starts at the execution of an STC instruction which initiates the transfer of the character. For a character acquired from the teleprinter keyboard unit, there must be added to the 0.1 second the period of waiting before a key is struck.

## 3-8. STATUS CHECK.

3-9. Before performing a computer input or output operation involving the teleprinter, the program can check the state of a busy bit acquired from the teleprinter interface card to determine whether the teleprinter is in use. To accomplish this, an LIA or LIB instruction is performed, using the select code of the teleprinter. The sign bit of the word acquired from the interface card is then checked by the program. If this busy bit is logic 1, the teleprinter is sending or receiving a character. If the sign bit is logic 0, the teleprinter is not sending or receiving a character.

3-10. It must be noted, however, that if a series of characters is being transferred, the busy bit becomes logic 0 between each character. The busy bit therefore is used principally for checking the completion of single-character I/O operations. If the teleprinter is set for off-line use or is not turned on, the busy bit is logic 0.

3-11. The busy bit becomes logic 1 during the STC instruction which initiates the transfer of a character to or from the teleprinter. It remains logic 1 until completion of transfer of the character. The busy bit then remains logic 0 until an STC instruction initiates the transfer of another character.

3-12. Table 3-1 shows a typical subroutine which checks the busy bit. The subroutine remains in a waiting loop if the teleprinter is transferring a character.

## 3-13. CONTROL WORD.

3-14. At the start of each teleprinter I/O operation, a control word is furnished to the teleprinter system to indicate whether an input or output operation is to be performed. In the case of the 2754B Teleprinter, the control word also specifies whether printing, punching, or both are to be performed. (In the 2752A Teleprinter, the punch functions must be selected manually at the teleprinter.) Table 3-2 shows the make-up of the control word, while table 3-3 shows the variations of the control word which can be used with the 2754B Teleprinter.

Table 3-1. Status Check Subroutine

| INSTRUCTION | REMARKS |
|---|---|
| LIA ZZ | This instruction, using the teleprinter select code, loads the busy bit in the sign position of the A-register. |
| SSA | This instruction causes a skip if the busy bit is logic 0. |
| JMP *-2 | This instruction brings about a program jump back to the LIA instruction. |
| - - - | From this point the program proceeds to a teleprinter input or output subroutine. |
| NOTE: ZZ is the teleprinter I/O select code. | |

Table 3-2. Control Word

| BIT | FUNCTION |
|---|---|
| 15 | Must be logic 1 to indicate that the word is a control word rather than a data word. |
| 14 | Logic 1 to indicate a computer input operation. Logic 0 to indicate an output operation. |
| 13* | Logic 1 to indicate that printing is to be performed. |
| 12* | Logic 1 to indicate that punching is to be performed. |
| 11 thru 0 | Perform no function and can be logic 1 or 0. |

*In the case of the 2752A Teleprinter these bits perform no function and can be logic 1 or 0.

## 3-15. PROGRAMMING METHODS.

3-16. As with many other HP input/output devices, programming procedures for the teleprinter can use either the skip-by-flag method or the interrupt method. Skip-by-flag has the advantage that the programming task is simplified; however, the program must remain in a 0.1 second waiting loop for each character transferred.

3-17. The discussion which follows deals first with skip-by-flag programming. Then the interrupt method is covered.

### 3-18. OUTPUT PROGRAMMING, SKIP-BY-FLAG METHOD.

3-19. Table 3-4 shows a subroutine for printing or punching one character, using the skip-by-flag method. When sending data to the teleprinter by this method, the computer I/O interrupt system must first be turned off; otherwise unwanted teleprinter program-interrupts will occur. The first instruction in table 3-4 turns off the interrupt system.

3-20. Turning off the I/O interrupt system does not disable the power-fail interrupt; nor is the parity-error interrupt or memory-protect interrupt affected, if the optional devices producing these interrupts are installed in the computer.

3-21. After the interrupt system is turned off, an LDA instruction loads the teleprinter control word in the A-register. From the A-register the control word is forwarded to the teleprinter system by an OTA instruction which uses the teleprinter I/O select code. Next, the 8-bit character to be printed or punched is loaded in the low-order end of the A-register by a second LDA instruction. After loading, position 15 of the A-register must contain logic 0 to indicate that a data word, rather than a control word, is being supplied to the teleprinter system. Then an OTA instruction, using the teleprinter I/O select code, transfers the eight bits to the interface card. Finally, an STC instruction with the teleprinter I/O select code initiates the print or punch operation. Approximately 0.1 second is required for the transfer of the character to the teleprinter. The SFS and JMP instructions in table 3-4 keep the routine in a waiting loop until all bits are transferred to the teleprinter. This waiting loop can be omitted if the interrupt system is to remain off.

Table 3-3. Control Words for 2754B Teleprinter

| CONTROL WORD (OCTAL) | FUNCTION |
|---|---|
| 110000 | Computer output, punch only. |
| 120000 | Computer output, print only. |
| 130000 | Computer output, print and punch. |
| 140000 | Computer input, no printing or punching. |
| 150000 | Computer input and punch. |
| 160000 | Computer input and print. |
| 170000 | Computer input, print and punch. |

3-22. The preceding paragraphs described the transfer of a single character to the teleprinter. If more than one

Table 3-4. Skip-by-Flag Output Routine for One Character

| INSTRUCTION | FUNCTION |
|---|---|
| CLF 00 | Turn off interrupt system. |
| LDA XX | Load control word (table 3-2) in A-register. |
| OTA ZZ | Transfer control word to teleprinter. |
| LDA YY | Place character in positions 7 through 0 of A-register. Position 15 of the A-register must contain logic 0. |
| OTA ZZ | Transfer character to teleprinter interface card. |
| STC ZZ,C | Clear teleprinter interface Flag FF, and start print or punch operation. |
| SFS ZZ | Check for completion of character transfer to teleprinter. |
| JMP *-1 | If Flag FF is clear (character transfer not complete), return to SFS instruction. |
| STF 00 | Turn on interrupt system. |

NOTES: XX is the core-storage location of the control word.
YY is the core-storage location of the character to be printed or punched.
ZZ is the teleprinter I/O select code.

To avoid an unwanted teleprinter interrupt, the interrupt system must not be turned back on until at least 0.1 second after the STC instruction.

character is to be transferred, the control word need not be forwarded again to the teleprinter system. After the first character, the following instructions are required for each additional character:

```
LDA YY
OTA ZZ
STC ZZ,C
SFS ZZ
JMP *-1
```

3-23. The symbols "YY" and "ZZ" above have the same significance as in table 3-4. The SFS and JMP instructions keep the program in a waiting loop for the 0.1-second period required for the transfer of each character to the teleprinter.

3-24. In a multiple-character transfer the I/O routine must include a means of advancing the core-storage address to acquire each successive character. A character count must also be maintained to determine when the I/O operation is complete.

3-25. INPUT PROGRAMMING, SKIP-BY-FLAG METHOD.

3-26. Table 3-5 shows a subroutine for acquiring one character from the teleprinter tape reader unit or keyboard unit. The skip-by-flag method is used, therefore the computer interrupt system must be turned off to avoid unwanted interrupts. The first instruction in table 3-5, CLF 00, performs this function. An LDA instruction then loads the teleprinter control word in the A-register, and an OTA instruction transfers the word to the teleprinter. Next, an STC instruction clears the teleprinter interface Flag FF, and either causes a character to be read from tape (if the teleprinter START/STOP/FREE switch is at the START position), or prepares the system for the striking of a teleprinter key. A waiting loop comprised of an SFS instruction and a JMP instruction awaits the transfer of a character from the teleprinter to the interface card.

Table 3-5. Skip-by-Flag Input Routine for One Character

| INSTRUCTION | FUNCTION |
|---|---|
| CLF 00 | Turn off interrupt system. |
| LDA XX | Load control word (table 3-2) in A-register. |
| OTA ZZ | Transfer control word to teleprinter system. |
| STC ZZ,C | Clear teleprinter interface Flag FF, and initiate acquisition of character from teleprinter tape reader unit or await striking of teleprinter key. |
| SFS ZZ | Check for completion of character transfer to interface card. |
| JMP *-1 | If Flag FF is clear (character transfer not complete), return to SFS instruction. |
| LIA YY | Flag FF is set. Transfer character from interface card to positions 7 through 0 of A-register. The remainder of the A-register is cleared. |
| STF 00 | Turn on interrupt system. |

NOTES: XX is the core-storage location of the control word.
ZZ is the teleprinter I/O select code.
YY is the core-storage location reserved for the character furnished by the teleprinter.

3-27. About 0.1 second is required to transfer a character to the interface card. The teleprinter interface card Flag FF is then set, and an LIA instruction loads the character in the low-order end of the A-register.

3-28. If more than one character is to be acquired from the teleprinter, the control word need not be forwarded again to the teleprinter. After receipt of the first character, the following instructions are required for the acquisition of each additional character:

```
STC ZZ,C
SFS ZZ
JMP *-1
LIA YY
```

3-29. The symbols "ZZ" and "YY" above have the same significance as in table 3-5. The SFS and JMP instructions keep the program in a waiting loop until a character is transferred from punched tape or until a key is struck. When reading from punched tape, the duration of the waiting loop is about 0.1 second. When acquiring a character from the keyboard, the waiting loop continues until about 0.1 second after a key is struck.

3-30. In a multiple-character transfer the I/O routine must include a means of advancing the core-storage address to acquire each successive character. A character count must also be maintained to determine when the I/O operation is complete.

3-31. OUTPUT OR INPUT PROGRAMMING, INTERRUPT METHOD.

3-32. When the interrupt I/O method is used, the I/O routine does not enter a waiting loop while a character is being transferred to or from the teleprinter. Instead, a different subroutine or program is performed during the waiting period. A teleprinter interrupt, occurring at the end of character transfer, brings about a return to the teleprinter I/O routine for completion of the operation.

3-33. The routine for transferring a character to or from the teleprinter is similar to that used for the skip-by-flag method. However, instead of a CLF instruction, an STF instruction with select code 00 (octal) is performed at the start of the routine. This instruction ensures that the interrupt system is turned on.

3-34. For an output operation, the method shown in table 3-6 is used. Table 3-7 shows an input operation.

3-35. In an output operation, if more than one character is to be transferred the following instructions are required for each additional character:

```
LDA YY
OTA ZZ
STC ZZ,C
JMP
```

3-36. For a multiple-character input operation, each additonal character requires the following:

```
STC ZZ,C
JMP
LIA ZZ (When a teleprinter interrupt occurs)
STA YY
```

3-37. The program or routine performed while awaiting an interrupt must not initiate a different teleprinter operation.

Table 3-6. Interrupt-Method Output Routine

| INSTRUCTION | FUNCTION |
|---|---|
| STF 00 | Ensure that the interrupt system is turned on. |
| LDA XX | Load control word (table 3-2) in A-register. |
| OTA ZZ | Transfer control word to teleprinter. |
| LDA YY | Place character in positions 7 through 0 of A-register. Position 15 of the A-register must contain logic 0. |
| OTA ZZ | Transfer character to teleprinter interface card. |
| STC ZZ,C | Clear teleprinter interface Flag FF, and start print or punch operation. |
| JMP | Jump to a different subroutine of program. |
| NOTES: When a teleprinter interrupt occurs, a JSB instruction produces a program jump to the routine for transferring the next character (if any) to the teleprinter.<br>XX is the core-storage location of the control word.<br>ZZ is the teleprinter I/O select code.<br>YY is the core-storage location of the character to be printed or punched. | |

Table 3-7. Interrupt-Method Input Routine

| INSTRUCTION | FUNCTION |
|---|---|
| STF 00 | Ensure that the interrupt system is turned on. |
| LDA XX | Load control word (table 3-2) in A-register. |
| OTA ZZ | Transfer control word to teleprinter. |
| STC ZZ,C | Clear teleprinter interface Flag FF, and initiate acquisition of character from teleprinter tape reader unit or await striking of teleprinter key. |
| JMP | Jump to a different subroutine or program. |
| When a teleprinter interrupt occurs, a JSB instruction produces a program jump to the remainder of the teleprinter I/O subroutine, below. | |
| LIA ZZ | Transfer character from interface card to positions 7 through 0 of A-register. The remainder of the A-register is cleared. |
| STA YY | Store the character. |
| NOTES: XX is the core-storage location of the control word.<br>ZZ is the teleprinter I/O select code.<br>YY is the core-storage location reserved for the character furnished by the teleprinter. | |

## 3-38. PARITY CHECKING.

### 3-39. INPUT.

3-40. Characters supplied by keys actuated at the teleprinter keyboard have a parity bit; even parity is used. (The early version of the 2752A Teleprinter did not have this feature.) Characters from punched tape have a parity bit if the tape was produced with this bit. In both cases, the parity bit is one of the eight bits provided, and in the case of a keyboard character it is placed in position 7 of the A- or B-register. No hardware check is made of the parity bit; but it can be checked by programming means, if desired.

### 3-41. OUTPUT.

3-42. No hardware check is made of parity bits furnished to the print unit or punch unit, nor is it possible to determine directly by programming means whether a parity error has occurred. In the case of punched tape, however, the tape can later be read and checked by a programmed parity test or by a comparison with the original data. If a parity bit is used with punched tape, a routine must determine whether logic 1 or 0 is required, and must establish the required bit in the 8-bit character. (That is, these functions are not performed by hardware.)

# SECTION IV

# THEORY OF OPERATION

## 4-1. INTRODUCTION.

4-2. This section explains the circuit theory of the buffered teleprinter interface card. The discussion concerns mainly teleprinter operations, but it is also applicable to use of the interface card with other types of I/O devices. Signal timing for other I/O devices may differ from teleprinter timing; and some I/O devices may use only a single stop bit, rather than the two used by the teleprinter.

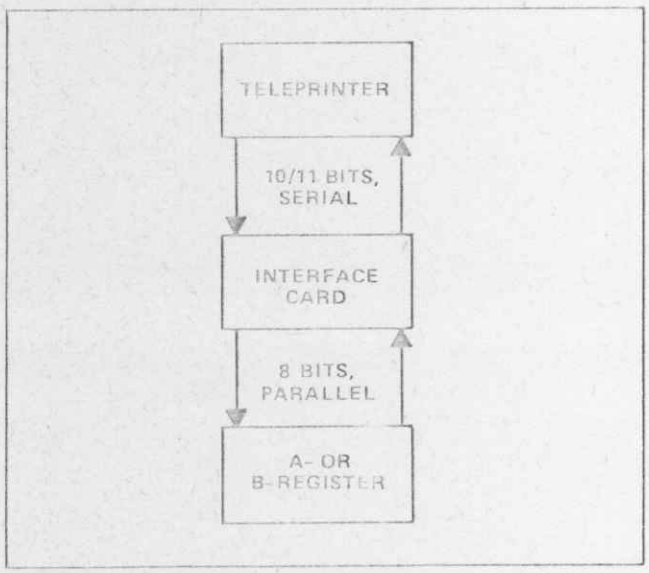
4-3. The term "input" in this section signifies data input to the computer, while "output" indicates output from the computer. Mention of the "keyboard", the "punch unit", and the "tape reader" refer to these units in the teleprinter.

4-4. Before starting the circuit theory discussion which follows, the reader should be familiar with the programming information provided in Section III of this manual.

4-5. During the theory discussion, reference should be made as required to figure 5-2, the logic diagram of the interface card.

## 4-6. DATA TRANSFER.

4-7. It has been noted that data is transferred to and from the teleprinter in the form of 8-bit words. These words are transferred in parallel between the A- or B-register and the interface card (figure 4-1). In an output operation the word is stored temporarily in a register on the interface card, and three bits are added to it. These are a start bit (logic 0), and two stop bits (logic 1's). The 11 bits are then transferred serially to the teleprinter, commencing with the start bit, and ending with the two stop bits (figure 4-2).




2154-8

Figure 4-1. Bit Transfer Method

4-8. In a teleprinter input operation, an 11-bit word is received by the interface card for each key struck or for each group of eight holes read from punched tape. The 11 bits are transferred serially to the register on the interface card. As in an output operation, the eight data bits are preceded by a start bit, and followed by two stop bits. At the interface card the start and stop bits are discarded, and the eight data bits are transferred in parallel from a register on the interface card to the A- or B-register. The upper waveform in the illustration appears at pins 16 and T of the interface card 48-pin connector when an "S" is transferred to the teleprinter. The lower waveform appears at pins 4 and D when an "S" is received from the teleprinter.

4-9. For the teleprinter, the serial transfer of each bit of an 11-bit word requires approximately 9.09 milliseconds. The entire 11 bits are transferred in about 0.1 second. The parallel transfer of 8-bit words between the interface card and the A- or B-register is completed within one computer machine cycle. Data transfer times are the same for input and output.

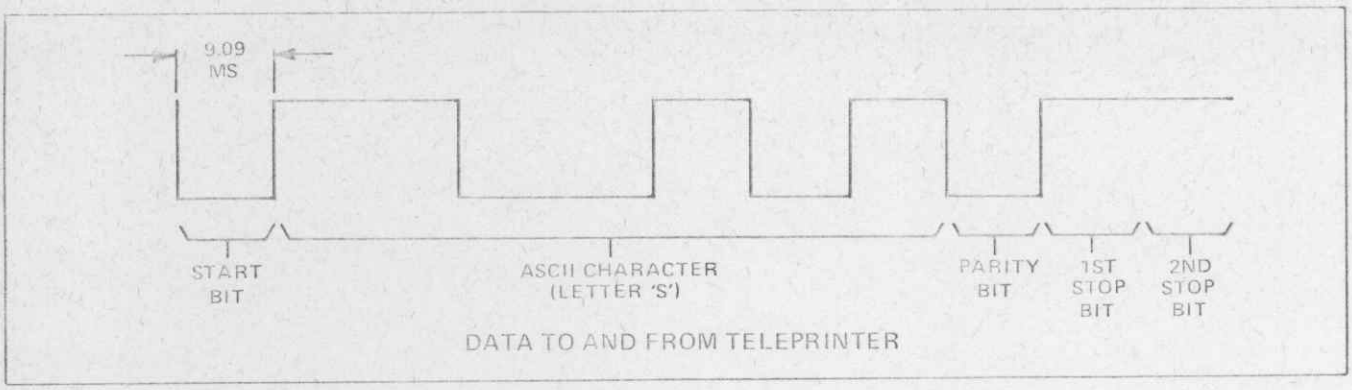
## 4-10. POWER-ON AND PRESET-SWITCH FUNCTIONS.

4-11. When power is initially applied to the computer, the interface card receives a POPIO(B) (Power On Pulse to I/O, Buffered) signal and a CRS (Control Reset to I/O) signal. (See figure 4-10.) Both signals consist of a train of T5 pulses, lasting for approximately 40 milliseconds during the power turn-on period. The POPIO(B) signal sets the Flag Buffer FF. The CRS signal clears the Control FF, the Clock Enable FF, the Print FF, the Punch FF, and the Read FF. Frequency Divider B is also cleared, and the In/Out FF is set.

4-12. When the Clock Enable FF is cleared by the CRS pulse, the set-side output of the flip-flop clears flip-flop U85A in the data register, and sets flip-flop U85B.

4-13. With the Print and Punch FFs in the clear condition, transistor Q4 is cut off, and the data line to the teleprinter is maintained at the logic 1 level.

4-14. An additional function during power turn-on is the setting of the Flag FF, and the clearing of the IRQ (Interrupt Request) FF. These actions are brought about by the ENF (Enable Flag) signal. The first of the ENF pulses clears the IRQ FF. Then, when the Flag Buffer FF is set by the POPIO pulse, the Flag FF is likewise placed in the set condition.




2154-7A

Figure 4-2. Data Waveforms (Typical) To and From Teleprinter

4-15. Summarizing the state of the interface card after power turn-on, the following conditions exist:

a. The Flag Buffer FF, the In/Out FF, flip-flop U85B in the data register, and the Flag FF are set.

b. Frequency divider B is cleared.

c. The Control FF, the Clock Enable FF, the Print FF, the Punch FF, the Read FF, flip-flop U85A in the data register, and the IRQ FF are in the clear condition.

d. The output data line to the teleprinter is at the logic 1 level.

4-16. Whenever power is applied to the computer and a program is not running, pressing the PRESET switch produces manually the same effects that occur during power turn-on.

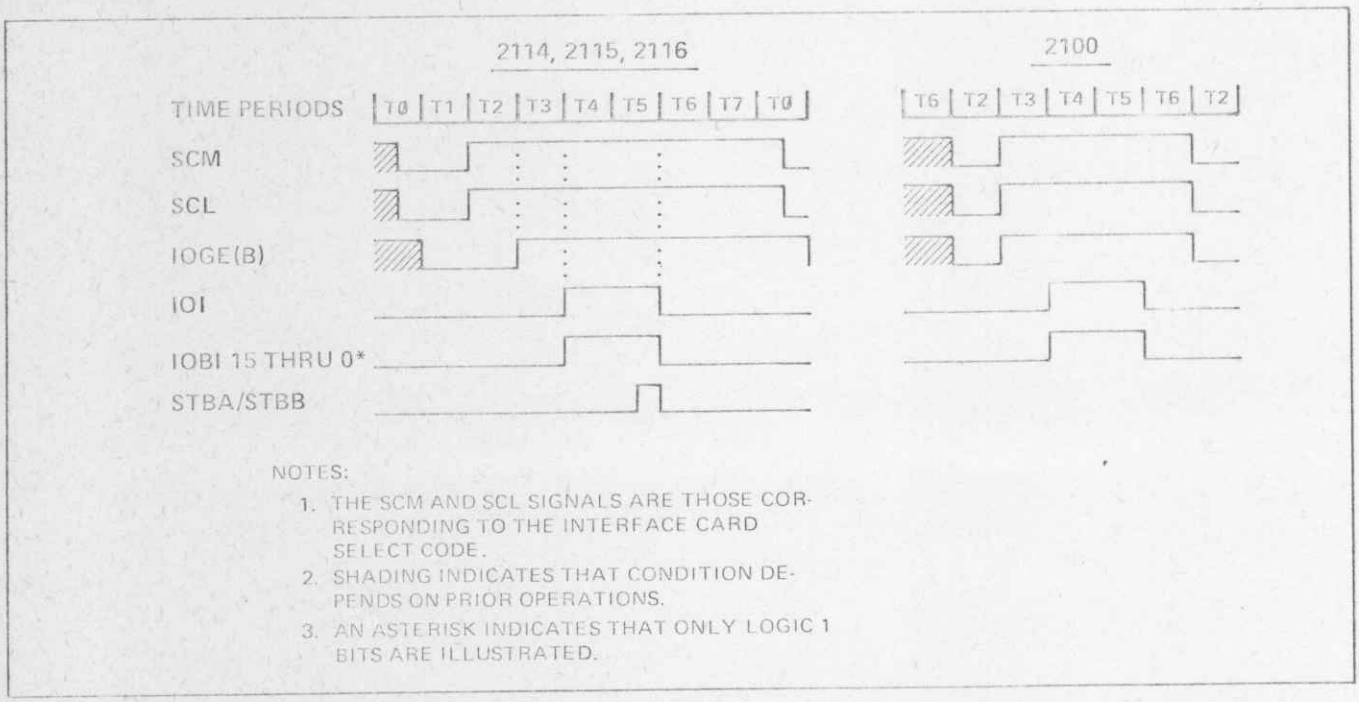
## 4-17. STATUS CHECK.

4-18. When an LIA or LIB instruction is performed to make a teleprinter status check, bit 15 of the A- or B-register is loaded from the IOBI 15 line. When the teleprinter is busy, the Clock Enable FF on the interface card is set, and the bit is logic 1. When the teleprinter is not busy, the flip-flop is clear, and the bit furnished is logic 0.

4-19. Timing relationships of signals generated by the LIA/B instruction are illustrated in figure 4-3. The STBA/STBB signal in the illustration is not furnished to the interface card; the signal loads the status bit into the A- or B-register.

## 4-20. INPUT OPERATION.

4-21. The paragraphs which follow describe a computer input operation. During the discussion, reference should be made as required to the flow chart in figure 4-11.




2154-2A

Figure 4-3. LIA/B Instruction, Timing Chart

4-22. OTA/B INSTRUCTION.

4-23. To prepare for an input operation, an OTA/B instruction transfers a control word to the interface card. Figure 4-4 illustrates the signals furnished to the card when the instruction is performed, and table 3-2 shows the format of the control word. To indicate an input operation, bit 14 of the control word is logic 1. As a result the In/Out FF is set, and this flip-flop brings about the following:

a. Enables gate U94C, permitting a clock pulse to be supplied to the Data Register FFs when the C FF becomes set.

b. Enables gate U34A, permitting the setting of the Clock Enable FF when the start bit is received from the teleprinter.

c. Enables gate U24B, permitting data received from the teleprinter to be returned to the teleprinter for printing or punching if the Print or Punch FF is set.

4-24. The IOO signal results in the clearing of flip-flop U95B and seven additional flip-flops in the data register. Flip-flop U124B in the register is set; the logic 1 from this flip-flop is later shifted down the register to flip-flop U85B, where it remains until the next teleprinter operation. This logic 1 maintains the logic 1 level required on the data line to the teleprinter when the teleprinter is not in use.

4-25. If characters furnished by the teleprinter are to be printed or punched by the teleprinter itself, the Print FF or Punch FF is set by the appropriate bit of control word. With the 2752A Teleprinter it is also necessary that manual controls on the teleprinter be set for the required function (print or punch).

4-26. STC INSTRUCTION.

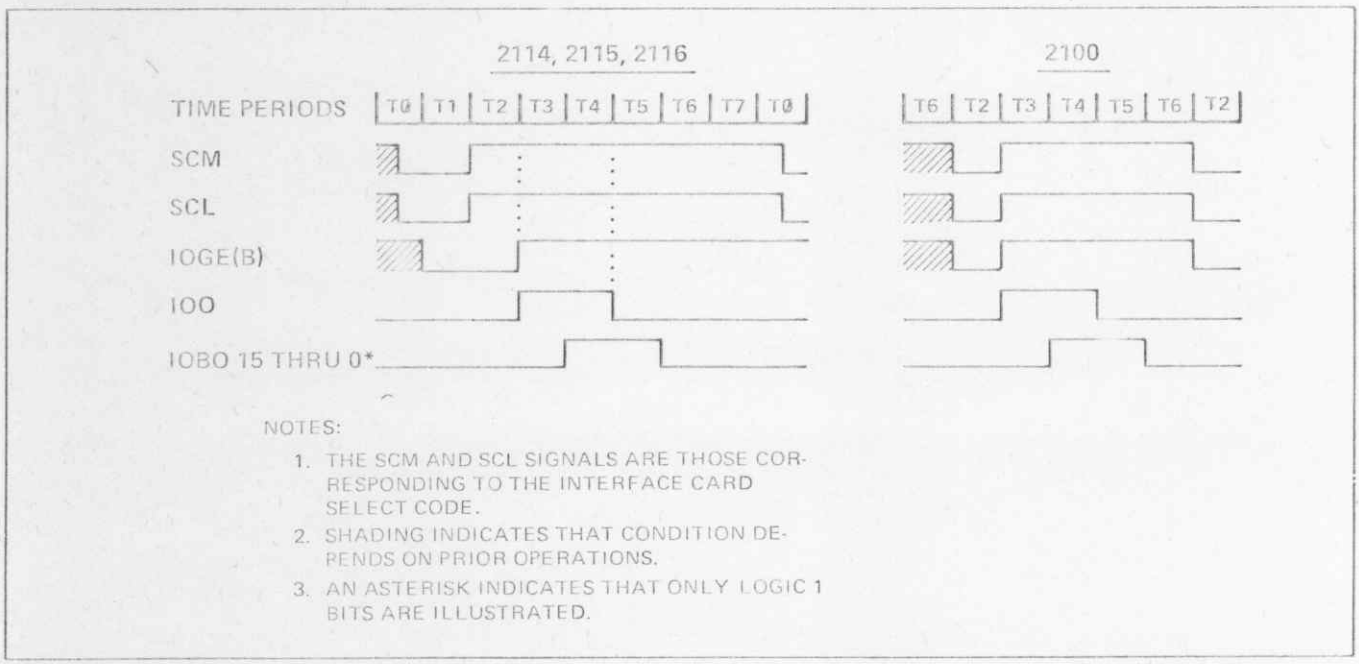
4-27. An STC instruction (figure 4-5) starts the transfer of a character from the teleprinter tape reader, or prepares for the receipt of characters from the keyboard. The H/C bit (hold/clear Flag FF bit) of the instruction word is logic 1. Consequently, the CLF signal becomes true at time T4, and the Flag Buffer FF and Flag FF are cleared.

4-28. The STC signal becomes true at T4, and the Control FF is set. If the I/O interrupt system is on, the set condition of the Control FF allows the IRQ FF to be set when a character has been transferred from the teleprinter to the data register on the interface card. With the IRQ FF set, a teleprinter interrupt occurs. If a skip-by-flag I/O operation is being performed, the Control FF and IRQ FF perform no useful function.

4-29. The STC signal also sets the Read FF. As a result, a Read Command signal is sent to the teleprinter. If the teleprinter tape reader is turned on, a set of eight holes is read from punched tape. If the tape reader is not turned on, operations await the striking of a key on the teleprinter keyboard. (The tape reader is turned on when the FREE/STOP/RUN switch on the 2754B Teleprinter is at the RUN position, or when the START/STOP/FREE switch on the 2752A Teleprinter is at the START position.)

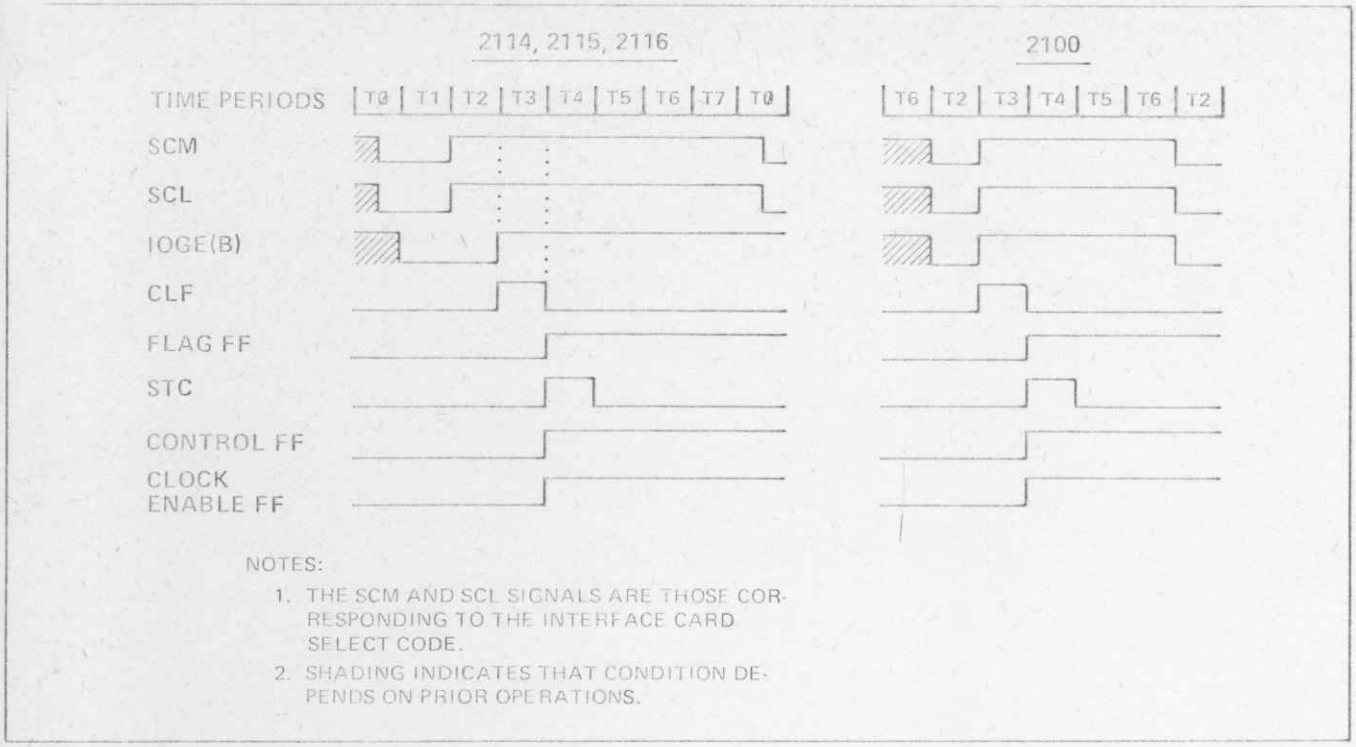
4-30. DATA TRANSFER.

4-31. After the STC instruction initiates the transfer of a character from the teleprinter, the computer either enters a waiting loop (for a skip-by-flag operation) or proceeds with another program or routine (in the case of an interrupt-type I/O operation).




2154-3A

Figure 4-4. OTA/B Instruction, Timing Chart




2154-4A

Figure 4-5. STC Instruction, Timing Chart

4-32. At the teleprinter, data transfer to the interface card commences when the tape reader reads a character or when a key on the keyboard is struck. As noted earlier, for each character 11 bits are transferred from the teleprinter to the interface card. These are furnished to pins 4 and D of the 48-pin connector on the card.

4-33. The data pulses are applied to a Schmitt trigger (Q1, Q2), which shapes the leading edges of the pulses. Transistor Q3 converts the Schmitt trigger output to the required voltage levels.

4-34. The start bit turns on the Clock Enable FF. Then, if jumper wire W1 is connected to terminal A (which is the case for teleprinter use), the clock pulses produced by frequency divider A are furnished to frequency divider B. If an external clock pulse is used, W1 is connected to terminal B, and frequency divider B receives externally produced clock pulses.

4-35. In the case of the teleprinter, jumper wire W2 is installed. Jumper W2 provides for a bit transfer rate of 110 bits per second. At this bit rate, the C FF in frequency divider B is set 4.545 milliseconds after the Clock Enable FF permits frequency divider B to commence operation. When set, the C FF furnishes a shift pulse to the data register flip-flops, and the start bit is shifted into flip-flop U124B. The 4.545-millisecond delay before the start bit is sampled eliminates problems arising from contact bounce. Every 9.09 milliseconds thereafter, another shift pulse is furnished to the data register flip-flops, and a new bit is shifted into the data register. Bits previously in the register are moved down the register one position each time a new bit is placed in flip-flop U124B. As with the start bit, each bit is sampled at the center of the data pulse. Figure 4-6 shows the timing relationships.

4-36. After 10 shifts, the start bit is in flip-flop U85A of the data register, the eight character-bits are in the flip-flops shown above U85A in the logic diagram, and the first stop bit is in flip-flop U124B. At this time the Counter Reset FF is cleared, and frequency divider B ceases functioning. As a result, no further shift pulses are supplied to the data register, and when the second stop bit is furnished by the teleprinter, it is not loaded into the register.

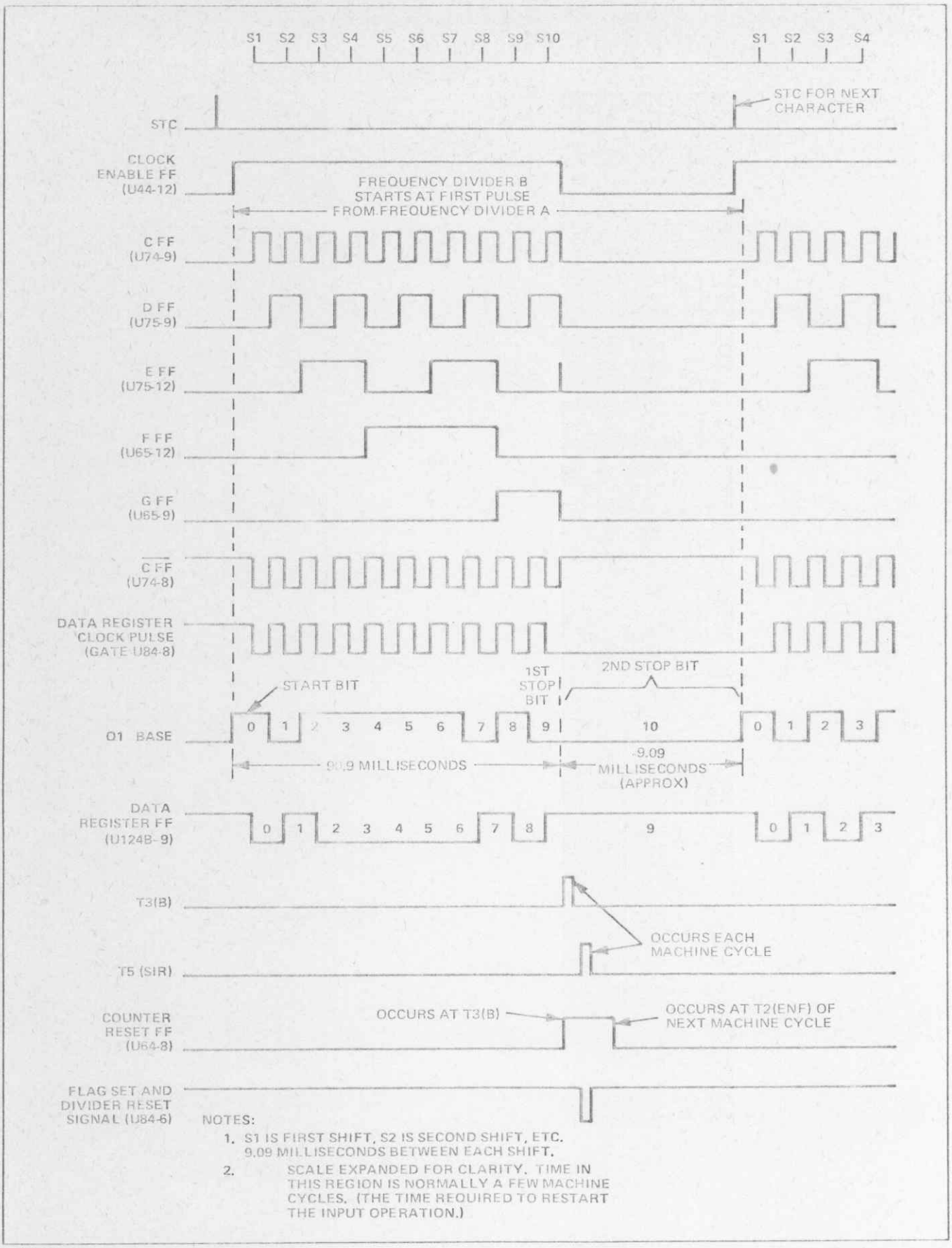
4-37. When frequency divider B is cleared, the Flag Buffer FF is set. This is followed by the setting of the Flag FF.

4-38. If a skip-by-flag I/O operation is being performed, the next execution of an SFS instruction results in the SKF signal becoming true (figure 4-7). A program skip then occurs.

4-39. If an interrupt-type I/O operation is being performed, the I/O interrupt system is on, and the IRQN signal is true. If the PRH signal also is true, the IRQ FF is set. The true IRQ and FLG signals bring about a program interrupt.

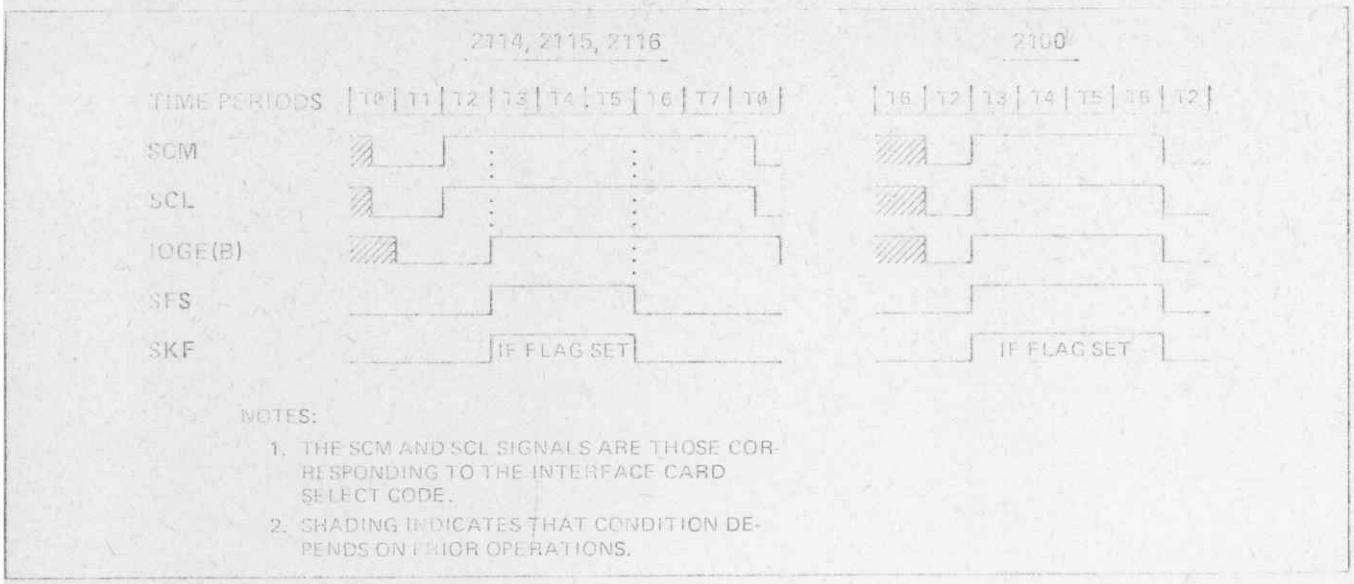
4-40. LIA/B INSTRUCTION.

4-41. An LIA/B instruction transfers the character from the data register on the interface card to the A- or B-register. The instruction strobes the gates at the outputs of the data register flip-flops, and the 8-bit character in the register is gated onto the IOBI-0 through IOBI-7 lines.




2154-11

Figure 4-6. Computer Input Operation (Teleprinter), Timing Chart




2154-5A

Figure 4-7. SFS Instruction, Timing Chart

From there, the character bits are gated into positions 0 through 7 of the A- or B-register. At this time the Clock Enable FF is clear, and logic 0 is gated into position 15 of the A- or B-register. The remaining positions of the A- or B-register are cleared.

4-42. OUTPUT OPERATION.

4-43. The paragraphs which follow describe a computer output operation. During the discussion, reference should be made as required to figure 4-12.

4-44. FIRST OTA/B INSTRUCTION.

4-45. In an output operation, an OTA/B instruction transfers a control word to the interface card. The functions of the control word are the same as for an input operation, except that the In/Out FF is cleared, rather than set. This results from the fact that bit 14 of the control word is logic 0. In the clear condition, the In/Out FF brings about the following:

a. Enables gate U34D, permitting the Clock Enable FF to be set when an STC instruction initiates the transfer of a character to the teleprinter.

b. Enables gate U94A, permitting a shift pulse to be sent to the data register each time the C FF is cleared.

c. Enables gate U55B, allowing frequency divider B to be stopped after 11 bits have been supplied to the teleprinter.

d. Enables gate U24C, permitting data to be forwarded from the data register to the teleprinter.

4-46. SECOND OTA/B INSTRUCTION.

4-47. After the control word has been furnished to the interface card, an OTA or OTB instruction forwards the 8-bit data word to the card. The bits are furnished via the IOBO-0 through IOBO-7 lines, and are placed in the data register. Prior to this, flip-flop U124B of the data register is set by a false input to its direct clear terminal, pin 10.

4-48. STC INSTRUCTION.

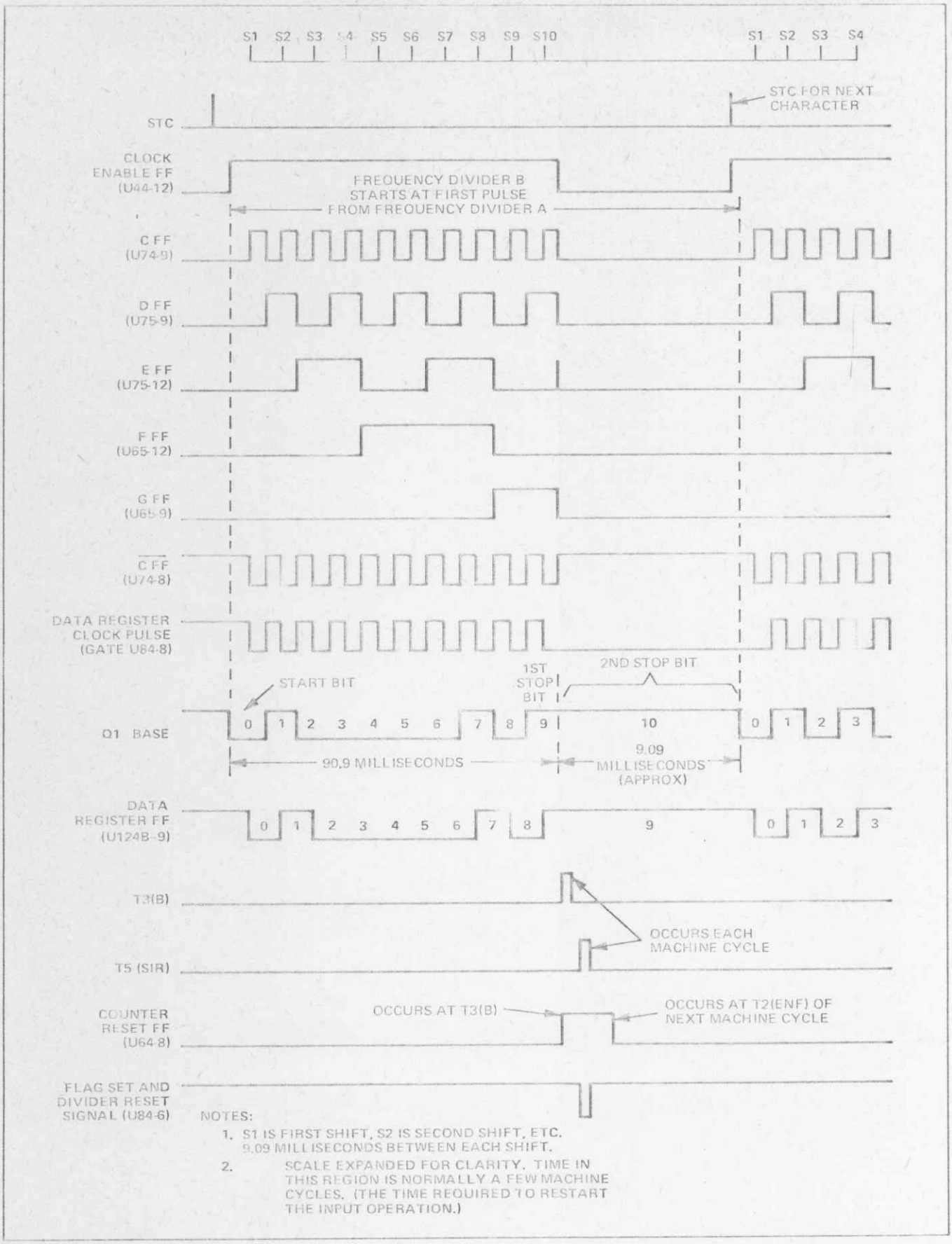
4-49. Following the loading of the data register on the interface card, an STC instruction is performed. This instruction clears the Flag Buffer FF and the Flag FF, and sets the Control FF and Clock Enable FF.

4-50. It has been seen that in an input operation the Clock Enable FF is set when a start bit is received from the teleprinter. In the output operation presently under discussion, this flip-flop is set as soon as the STC instruction initiates data transfer operations.

4-51. DATA TRANSFER.

4-52. With the Clock Enable FF set, frequency divider B starts operating (figure 4-8). Previously, flip-flop U85B in the data register was set and U85A was cleared by the set-side output of the Clock Enable FF. With U85B set, the data line to the teleprinter (pins 16 and T of the 40-pin connector) is true. When frequency divider B has been operating for 4.545 milliseconds, the C FF is set. After another 4.545 milliseconds, the C FF is cleared. At this time a shift pulse is furnished to the data register, and the logic 0 in flip-flop U85A is shifted into U85B. The other bits in the data register also are shifted downward one position in the register. When U85B receives the logic 0, the data line to the teleprinter becomes false. This false level is the start bit for the teleprinter, and mechanical functions in the teleprinter commence. Each 9.09 milliseconds thereafter the C FF is cleared, and a new bit is furnished to the teleprinter.

4-53. When the contents of the data register have been shifted for the eleventh time, the 11 bits initially in the




2154-11A

Figure 4-8. Computer Output Operation (Teleprinter), Timing Chart

data register have all been transferred to the teleprinter. The last two bits are the stop bits. The first of these results from the setting of flip-flop U124B of the data register by the OTA/B instruction which loaded the register. The second stop bit results from the fact that U124B remains in the set condition after the first shift. (In effect, a logic 1 is placed in U124B each time a shift takes place because the output of gate U104C is true.)

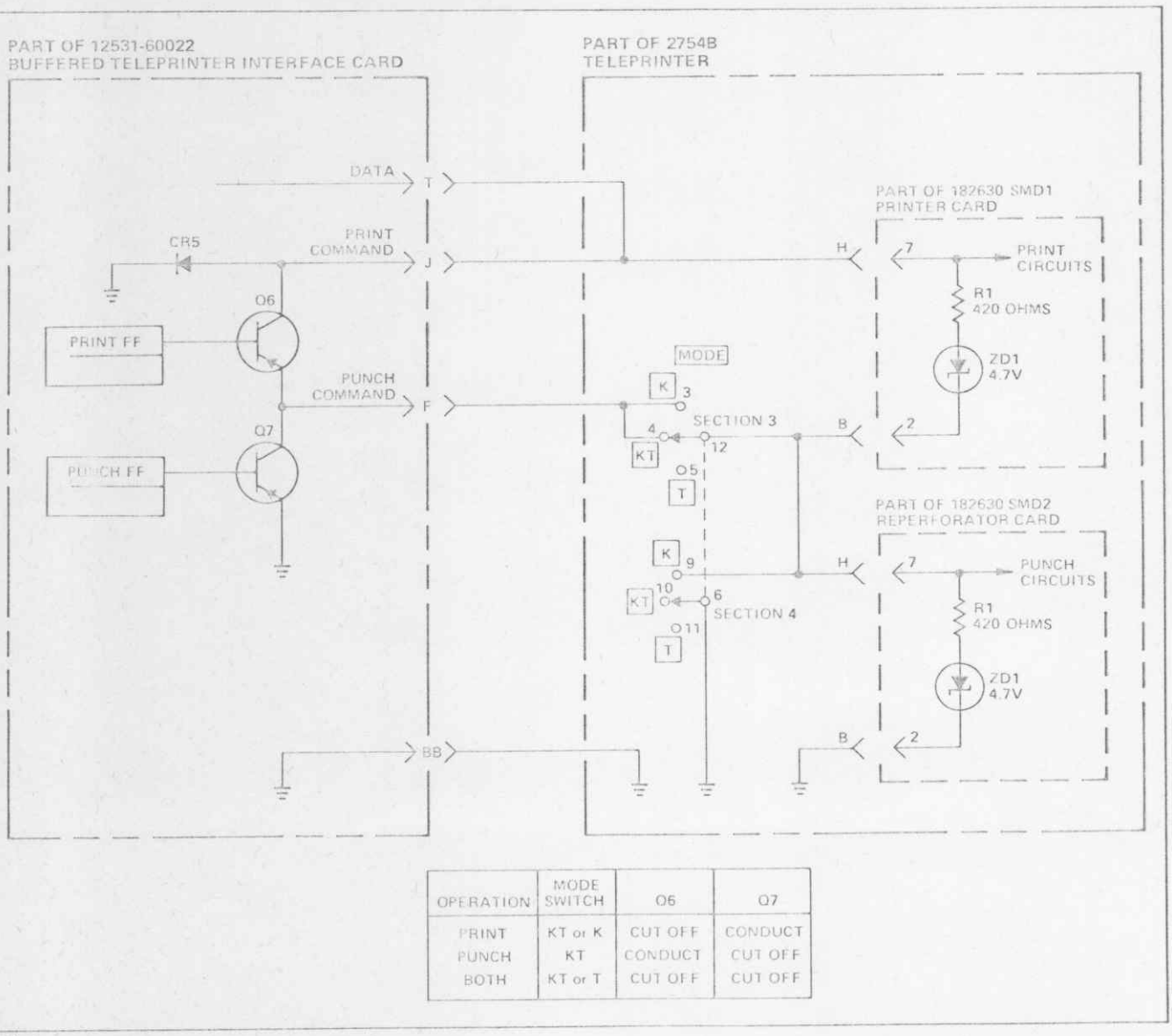
4-54. At the eleventh shift, frequency divider B is cleared and the Flag Buffer FF is set. Shortly thereafter the Flag FF is set. A program skip then occurs (for a skip-by-flag operation) or an interrupt takes place.

## 4-55. PRINT AND PUNCH CONTROL CIRCUITS.

4-56. Figure 4-9 illustrates the circuits which permit program selection of printing or punching in the 12754B Teleprinter. (As pointed out earlier, the 2752A Teleprinter requires manual selection of these functions.) The Print FF is set for printing, and the Punch FF is set for punching. The flip-flops are placed in the desired state by the control word which is sent to the interface card before the start of data transfer.

4-57. In a print-only operation, the Punch FF is clear and the Print FF is set. Consequently, transistor Q7 conducts heavily and Q6 is cut off. When data transfer begins, the data bits are developed across resistor R1 and diode ZD1 of the SMD1 printer card. Pin 2 of this card is maintained at close to ground potential because Q7 is conducting. No voltage is developed across R1 and ZD1 of the SMD2 reperforator card because Q7 shorts the input to the card.

4-58. When a punch-only operation is performed, Q6 conducts heavily and Q7 is cut off. As a result, the data signal passes through Q6 and is developed in the SMD2 card only. When printing and punching are conducted simul-




| OPERATION | MODE SWITCH | Q6 | Q7 |
|---|---|---|---|
| PRINT | KT or K | CUT OFF | CONDUCT |
| PUNCH | KT | CONDUCT | CUT OFF |
| BOTH | KT or T | CUT OFF | CUT OFF |

2154-1

Figure 4-9. 2754B Teleprinter Print and Punch Control Circuits, Simplified Schematic Diagram

taneously, Q6 and Q7 are both cut off. Consequently, half the signal voltage is developed in the SMD1 card, and half in the SMD2 card. The circuits are designed to function normally on this half voltage.

4-59. Diode CR5 prevents damage to Q6 and Q7 in the event that the 48-pin connector for the interface card is removed while the computer is turned on. If the ground pins in the connector break contact before the pins carrying the print command and punch command signals, excessive voltage is applied to the collector or Q6. This high voltage would destroy Q6 and Q7 if not bypassed by CR5.

CAUTION

Regardless of the protective function of diode CR5, always turn off computer power before removing the 48-pin connector. The diode itself could be defective, eliminating protection.

## 4-60. EIA COMPATIBLE DEVICE OPERATION.

4-61. The interface card can be used with a Bell series 103A Data-Phone (or other terminals such as the HP 2749A or 2600A) instead of a teleprinter. As with the teleprinter, characters transferred to the devices each consist of 11 bits, including a start bit and two stop bits. Characters from these devices may be 10 or 11 bits depending on whether one or two stop bits are supplied. However, the data waveforms entering and leaving the interface card are inverted from those associated with the teleprinter. Therefore, the waveforms shown in figure 4-2 must be inverted for Data-Phone application.

4-62. As well as being inverted, the signal waveforms for the Data-Phone have different levels from the teleprinter signals. Table 1-1 specifies these levels.

4-63. Data bits from these devices are applied to pin X on the interface card. Transistor Q8 inverts the signal and changes its voltage levels to correspond to those from the teleprinter. The 48-pin plug used on the interface card has a jumper connecting pin Y with pins 4 and D. Thus, after inverting and level shifting, the signal is applied to the circuit card as if it were from the teleprinter.

4-64. Output data signals leave the interface card from pins 16 and T of the 48-pin connector. A jumper connects these pins to pin V. The level is changed and the signal is inverted by transistor Q9. Pin W transfers the outgoing signal to the I/O device. Pins 17 and U furnish +12 volts for use by the Data-Phone or terminal.

# SECTION V

# MAINTENANCE

## 5-1. INTRODUCTION.

5-2. This section provides maintenance information for the 12531-60022 Buffered Teleprinter Interface Card. Included are corrective maintenance instructions and reference data for troubleshooting. Tables and diagrams presented in this section are arranged in the following order:

a. Sample I/O test programs (table 5-1).
b. Connections to 2752A Teleprinter (table 5-2).
c. Connections to 2754B Teleprinter (table 5-3).
d. Interface card replaceable parts list (table 5-4).
e. Integrated circuit pin connections and characteristics (figure 5-1).
f. Interface card parts location and logic diagram (figure 5-2).

## 5-3. PREVENTIVE MAINTENANCE.

5-4. Preventive maintenance for the interface kit is performed at the same intervals as for the computer system as a whole.

5-5. Preventive maintenance consists of inspecting the interface card for burned or broken components, or the presence of foreign material. The cable and connector which attach to the front of the card should also be checked for damaged insulation, bent or broken pins, etc. After any damage has been repaired, run the off-line diagnostic program (if any) for the I/O device. (The applicable off-line diagnostic program is specified in the operating and service manual for the device.) Finally, run an on-line diagnostic program to check the interface card with the I/O device connected. For the teleprinter, use the on-line diagnostics designated in paragraph 2-18. Procedures for running diagnostic programs are described in the *Manual of Diagnostics*.

## 5-6. CORRECTIVE MAINTENANCE.

### 5-7. GENERAL.

5-8. Most malfunctions of the interface card can be traced by performing the teleprinter diagnostic program and analyzing error halts as they occur. Oscilloscope checks facilitate localizing the fault to a component.

5-9. When performing troubleshooting, refer to figures 5-1 and 5-2. Table 5-1 contains sample programs for testing data transfer between the computer and the I/O device. Connections to the interface card 48-pin connector are listed in tables 5-2 and 5-3. Parts information is provided in table 5-4. For connections to the 86-pin connector, refer to the computer installation and maintenance manual.

### 5-10. SIGNAL VOLTAGES.

5-11. The voltages of teleprinter signals entering and leaving the interface card are listed in table 1-1.

5-12. For voltage levels of signals received by the interface card from the computer, refer to the computer installation and maintenance manual.

5-13. To determine the input voltages, output voltages, and circuit delay of integrated circuits on the interface card, first find the integrated circuit diagram in figure 5-1. Then refer to the appropriate characteristic at the bottom of the figure.

Table 5-1. Sample Input/Output Test Programs

Input Program

```
40    CLC   00     Turn off I/O interrupt system
      LDA   71     Load A-register with control word
      OTA   SC     Output control word
      STC   SC,C   Set control, clear flag
      SFS   SC     Wait for flag
      JMP   *-1
      LIB   SC     Input data word
      OTB   01     Output data word (000101₈)
                   to Switch Register (2114 and
                   2100 Computers only)
      JMP   40     Return for next data word
71    160000       Control word
```

Output Program

Set the Switch Register to $123202_8$

```
20    CLC   00     Turn off I/O interrupt system
      LIA   01     Load data from Switch Register
      OTA   SC     Output data word
      STC   SC,C   Set control, clear flag
      SFS   SC     Wait for flag
      JMP   *-1
      JMP   20     Return for next output
```

Table 5-2. Connections to 2752A Teleprinter

| INTERFACE CARD PIN | WIRE COLOR | TELEPRINTER CONNECTION* | SIGNAL |
|---|---|---|---|
| 4,D | Black | Pin 3 of teleprinter rear connector | Computer input data |
| 12,N | Red | +12 volt input on card assembly** (one end of resistor R1) | +12 volts |
| 14,R | White-brown | -12 volt input on card assembly** (one end of resistor R3) | -12 volts |
| 16,T | Green-orange | Pin 7 of teleprinter rear connector | Computer output data |
| 13,P | Yellow | Read command input to card assembly** (junction of resistors R1 and R2) | Read command |
| 24,BB | Cable shield | Ground connection on card assembly** (emitter of transistor Q2) | Ground |

NOTES: *Refer to the schematic diagram in the HP 2752A Teleprinter manual for components specified in this table.
**"Card assembly" refers to the printed circuit card added during modification of the Teletype Corporation Model ASR-33 Teletypewriter Set.

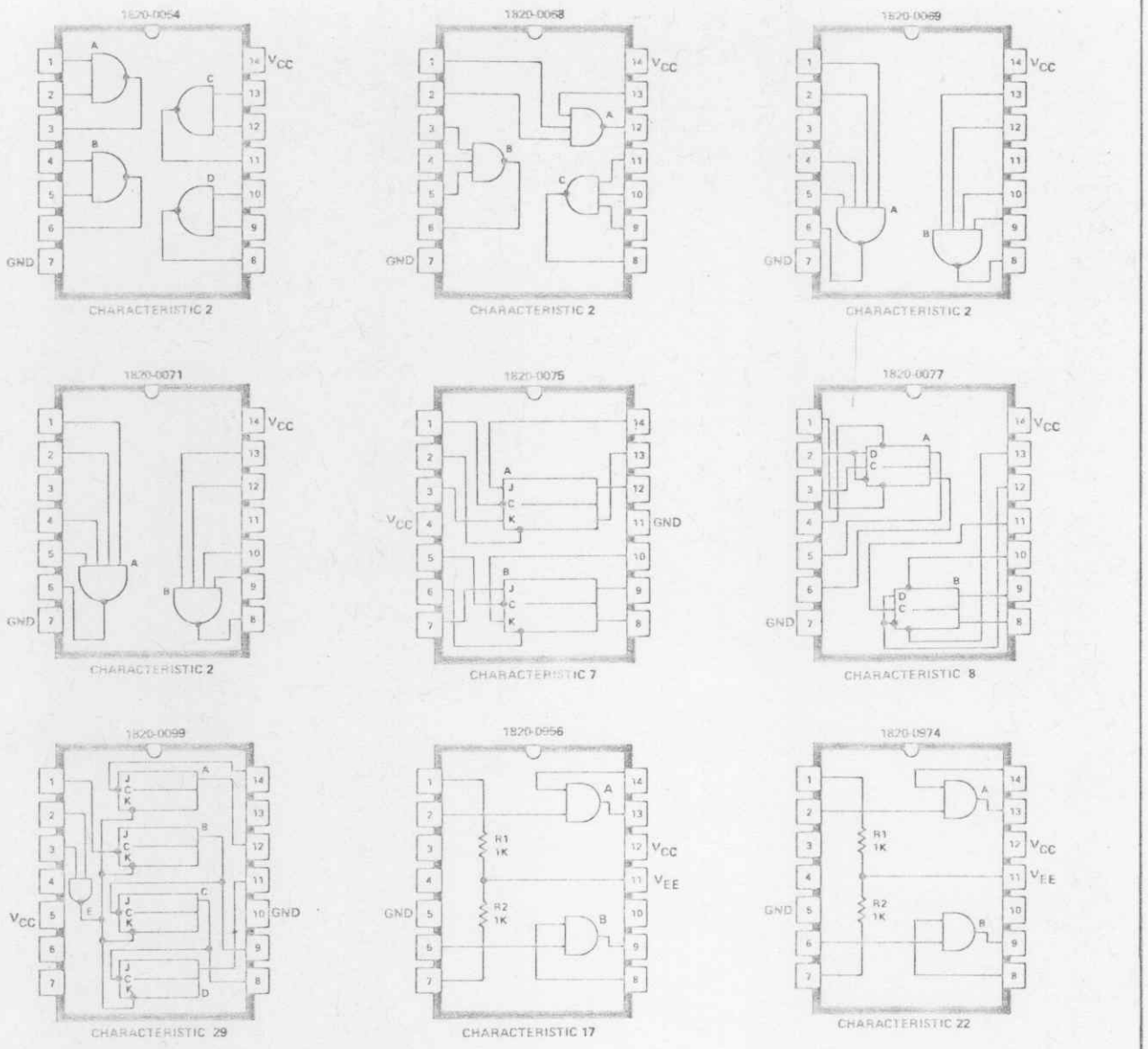
Table 5-3. Connections to 2754B Teleprinter

| INTERFACE CARD PIN | WIRE COLOR | TELEPRINTER CONNECTION* | SIGNAL |
|---|---|---|---|
| 4,D | Black | Terminal T6 | Computer input data |
| 12,N | Red | +12-volt input on card assembly** (one end of resistor R1) | +12 volts |
| 14,R | Brown | -12-volt input on card assembly** (one end of resistor R3) | -12 volts |
| 16,T | White | Terminal T7 | Computer output data |
| 13,P | Yellow | Read command input to card assembly** (junction of resistors R1 and R2) | Read command |
| 24,BB | White, black, & cable shield | Ground connection on card assembly** (emitter of transistor Q2) | Ground |
| 6,F | Orange | Terminal T8 | Punch Control |
| 8,J | Green | Terminal T4 | Print Control |

NOTES: *Refer to the schematic diagram in the HP 2754B Teleprinter manual for components specified in this table.
**"Card assembly" refers to the printed circuit card added during modification of the Teletype Corporation Model ASR-35 Teletypewriter Set.

Table 5-4. Buffered Teleprinter Interface Card, Replaceable Parts List

| REFERENCE DESIGNATION | HP PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. |
|---|---|---|---|---|
| C1 | 0160-0263 | Capacitor, Fxd, Cer, 0.22 uF, 20%, 50 VDCW | 56289 | 5C52BS-CML |
| C2 | 0160-0153 | Capacitor, Fxd, My, 1000 pF, 10%, 200 VDCW | 56289 | 192P10292-PTS |
| C4 | 0160-2940 | Capacitor, Fxd, Mica, 470 pF, 5%, 300 VDCW | 72136 | RMD15F471J3C |
| C5 | 0140-0191 | Capacitor, Fxd, Dipped Mica, 56 pf, 5% | 28480 | 0140-0191 |
| C8, 10, 12 thru 24 | 0180-0291 | Capacitor, Fxd, Elect, 1 uF, 10%, 35 VDCW | 56289 | 150D105X9035A2 |
| C9 | 0180-0338 | Capacitor, Fxd, Elect, 25 uF, +75 -10%, 25 VDCW | 28480 | 0180-0338 |
| CR1 | 1902-0022 | Diode, Breakdown, 2.67V | 04713 | SZ10939-16 |
| CR2, 3, 7, 8 | 1910-0030 | Diode, Ge, 100 mA, 0.65V | 28480 | 1910-0030 |
| CR4 | 1910-0022 | Diode, Ge, 5 WIV | 14433 | G401 |
| CR5 | 1901-0460 | Diode, Si, 3 junction stabistor | 03508 | STB523 |
| L2, 3 | 9140-0082 | Coil, Fxd, RF, 15 uH | 28480 | 9140-0082 |
| Q1, 2, 3 | 1854-0094 | Transistor, Si, NPN | 80131 | 2N3646 |
| Q4, 5 | 1854-0215 | Transistor, Si, NPN | 80131 | 2N3904 |
| Q6, 7 | 1853-0036 | Transistor, Si, PNP | 80131 | 2N3906 |
| Q8, 9 | 1853-0058 | Transistor, Si, PNP | 80131 | 2N3644 |
| Q10, 11, 12 | 1854-0071 | Transistor, Si, NPN | 28480 | 1854-0071 |
| R1 | 0698-3635 | Resistor, Fxd, Met Ox, 680 ohms, 5%, 2W | 28480 | 0698-3635 |
| R3, 21, 25 | 0698-0084 | Resistor, Fxd, Flm, 2.15k, 1%, 1/8W | 28480 | 0698-0084 |
| R4 | 0698-3153 | Resistor, Fxd, Flm, 3.83k, 1%, 1/8W | 28480 | 0698-3153 |
| R5 | 0757-0421 | Resistor, Fxd, Flm, 825 ohms, 1%, 1/8W | 28480 | 0757-0421 |
| R6 | 0757-0274 | Resistor, Fxd, Flm, 1.21k, 1%, 1/8W | 28480 | 0757-0274 |
| R7, 29 | 0698-3132 | Resistor, Fxd, Flm, 261 ohms, 1%, 1/8W | 28480 | 0698-3132 |
| R8, 27, 31 | 0757-0442 | Resistor, Fxd, Flm, 10.0k, 1%, 1/8W | 28480 | 0757-0442 |
| R9, 45 | 0698-3155 | Resistor, Fxd, Flm, 4.64k, 1%, 1/8W | 28480 | 0698-3155 |
| R10 | 0698-3154 | Resistor, Fxd, Flm, 4.22k, 1%, 1/8W | 28480 | 0698-3154 |
| R11, 28, 38, 48 | 0757-0280 | Resistor, Fxd, Flm, 1k, 1%, 1/8W | 28480 | 0757-0280 |
| R12 | 0698-0090 | Resistor, Fxd, Flm, 464 ohms, 1%, 1/2W | 28480 | 0698-0090 |
| R13 | 1810-0008 | Resistor, Network (6 fxd flm resistors) | 28480 | 1810-0008 |
| R14, 15, 17, 18 | 1810-0020 | Resistor, Network (7 fxd flm resistors) | 28480 | 1810-0020 |
| R16 | 0757-0344 | Resistor, Fxd, Flm, 51.1 ohms, 2%, 1/8W | 28480 | 0757-0894 |
| R22, 24 | 0698-0085 | Resistor, Fxd, Flm, 2.61k, 1%, 1/8W | 28480 | 0698-0085 |
| R23, 26 | 0757-0200 | Resistor, Fxd, Flm, 5.62k, 1%, 1/8W | 28480 | 0757-0200 |
| R30 | 0757-1078 | Resistor, Fxd, Flm, 1.47k, 1%, 1/2W | 28480 | 0757-1078 |
| R32 (revision 1117) | 0757-0461 | Resistor, Fxd, Flm, 68.1k, 1%, 1/8W | 28480 | 0757-0461 |
| R32 (revision 1120) | 0698-3154 | Resistor, Fxd, Flm, 4.22k, 1%, 1/8W | 28480 | 0698-3154 |
| R33 (revision 1117) | 0757-0446 | Resistor, Fxd, Flm, 15k, 1%, 1/8W | 28480 | 0757-0446 |
| R33 (revision 1120) | 0757-0427 | Resistor, Fxd, Flm, 1.5k, 1%, 1/8W | 28480 | 0757-0427 |
| R34 | 0575-0439 | Resistor, Fxd, Flm, 6.81k, 1%, 1/8W | 28480 | 0757-0439 |
| R35 | 0698-3152 | Resistor, Fxd, Flm, 3.48k, 1%, 1/8W | 28480 | 0698-3152 |
| R36 | 0698-0082 | Resistor, Fxd, Flm, 464 ohms, 1%, 1/8W | 28480 | 0698-0082 |
| R37 | 0698-3151 | Resistor, Fxd, Flm, 2.87k, 1%, 1/8W | 28480 | 0698-3151 |
| R43 | 0698-3440 | Resistor, Fxd, Flm, 196 ohms, 1%, 1/8W | 28480 | 0698-3440 |
| R44 | 0698-3445 | Resistor, Fxd, Flm, 348 ohms, 1%, 1/8W | 28480 | 0698-3445 |
| R46, 47 | 0757-1094 | Resistor, Fxd, Flm, 1.47k, 1%, 1/8W | 28480 | 0757-1094 |
| U14, 17, 27 | 1820-0956 | Integrated Circuit, CTL | 07263 | SL3459 |
| U15 | 1820-0069 | Integrated Circuit, TTL | 01295 | SN4344 |
| U16, 25, 34, 36, 45, 46, 55, 56, 76, 86, 94, 104 | 1820-0054 | Integrated Circuit, TTL | 01295 | SN4342 |
| U24, 26, 35, 44 | 1820-0068 | Integrated Circuit, TTL | 12040 | SN7140N |
| U41, 42 | 1820-0099 | Integrated Circuit | 01295 | SN7493N |
| U54, 66, 84 | 1820-0071 | Integrated Circuit, TTL | 01295 | SN7440N |
| U64, 65, 74, 75 | 1820-0075 | Integrated Circuit, TTL | 01295 | SN4353 |
| U85, 95, 105, 114, 115, 124, 125 | 1820-0077 | Integrated Circuit, TTL | 01295 | SN4354 |
| U96, 106, 116, 126, 127 | 1820-0974 | Integrated Circuit, CTL | 07263 | SL4817 |
| W1, 2, 3, 4, 5, 6 | 8159-0005 | Jumper Wire | 28480 | 8159-0005 |
| XY1 | 1200-0199 | Socket, Crystal | 28480 | 1200-0199 |
| Y1 | 0410-0421 | Crystal, Quartz, 225.280 kHz, 0.01% | 28480 | 0410-0421 |

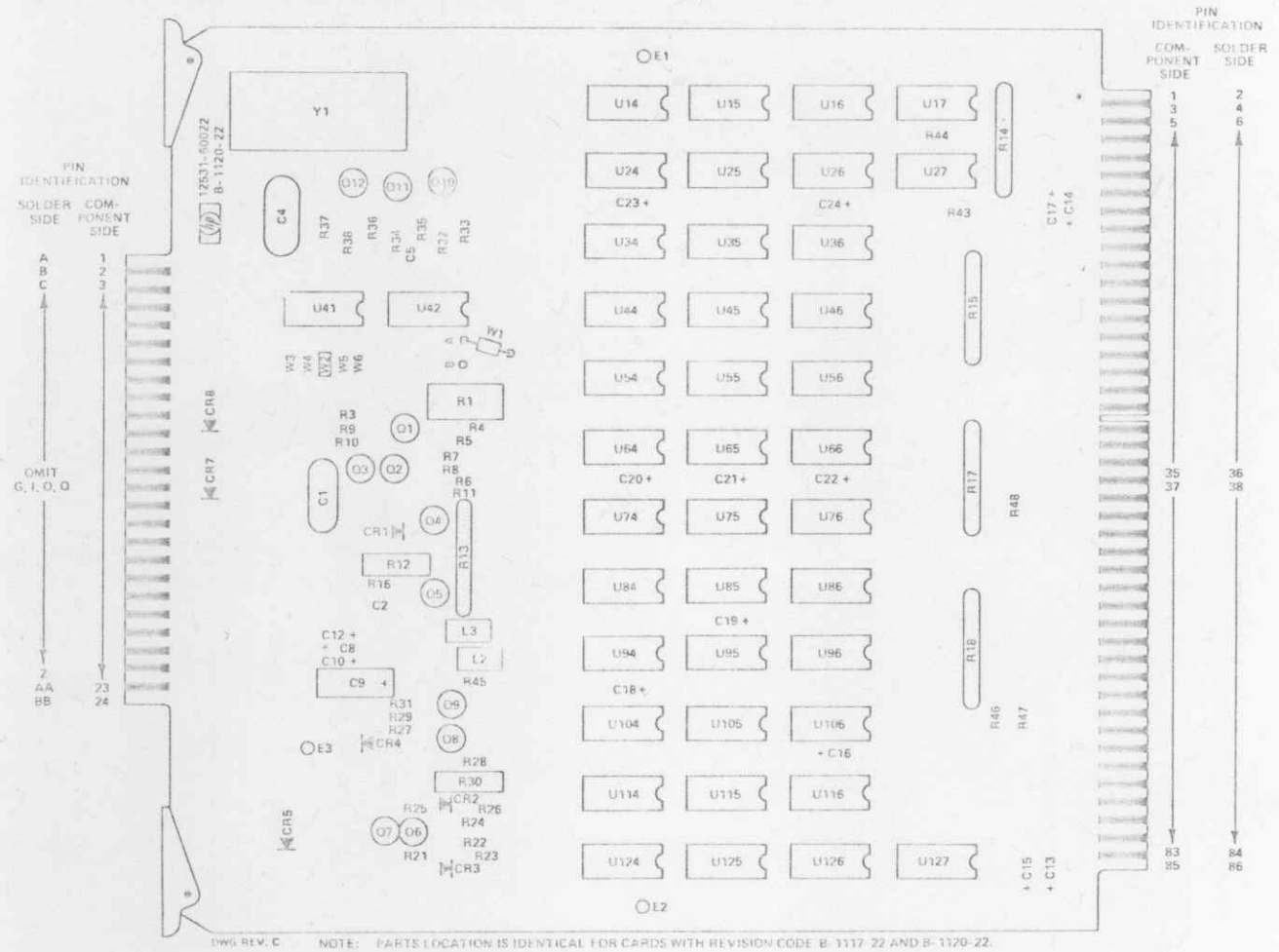



NOTE: PINS FACE AWAY FROM VIEWER.

| CHARACTERISTIC | INPUT LEVEL | | OUTPUT LEVEL | | OPEN INPUT ACTS AS: | MAXIMUM PROPAGATION DELAY | |
|---|---|---|---|---|---|---|---|
| | LOGIC 1 (VOLTS, MIN) | LOGIC 0 (VOLTS, MAX) | LOGIC 1 (VOLTS, MIN) | LOGIC 0 (VOLTS, MAX) | | TO LOCIC 1 (NANOSECONDS) | TO LOGIC 0 (NANOSECONDS) |
| 2 | 2.0 | 0.8 | 2.4 | 0.4 | Logic 1 | 29 | 15 |
| 7 | 2.0 | 0.8 | 2.4 | 0.4 | Logic 1 | 50 | 50 |
| 8 | 2.0 | 0.8 | 2.4 | 0.4 | Logic 1 | 35 | 50 |
| 17 | 1.25 | 0.5 | 2.25 | -0.36 | Logic 0 | 18 | 18 |
| 22 | 1.5 | 0.4 | 2.2 | -0.3 | Logic 0 | 24 | 24 |
| 29 | 2.0 | 0.8 | 2.4 | 0.4 | Logic 1 | 135 | 135 |

2154-12

Figure 5-1. Integrated Circuit Pin Connections and Characteristics




DWG REV. C NOTE: PARTS LOCATION IS IDENTICAL FOR CARDS WITH REVISION CODE B-1117-22 AND B-1120-22.

# SECTION VI

# REPLACEABLE PARTS

## 6-1. INTRODUCTION.

6-2. This section provides information for ordering replacement parts for the 12531C Buffered Teleprinter Interface Kit.

6-3. Table 6-1 lists parts in numerical order by HP part number and gives the total quantity for each replaceable part in the interface kit. A replaceable parts list (table 5-4) and parts location diagram (figure 5-2) for the interface card are provided in section V of this manual.

6-4. Tables 6-1 and 5-4 list the following information for each part:

a. Reference designation of the part (table 5-4 only). Refer to table 6-3 for an explanation of abbreviations used in the "REFERENCE DESIGNATION" column.

b. Hewlett-Packard part number.

c. Description of the part. Refer to table 6-3 for an explanation of the abbreviations used in the "DESCRIPTION" column.

d. A five digit code that identifies the manufacturer of the part. Refer to table 6-2 for a listing of the manufacturers that correspond to the codes.

e. Manufacturer's part number.

f. Total quantity (TQ) of each part used in the kit or assembly (table 6-1 only).

## 6-5. ORDERING INFORMATION.

6-6. To order replacement parts or to obtain information on parts, address the order or inquiry to the local Hewlett-Packard Sales and Service Office. (Sales and Service Offices are listed at the back of this manual.) Specify the following information for each part ordered:

a. Identification of the instrument, kit, or assembly containing the part (refer to paragraph 1-10).

b. Hewlett-Packard part number for each part.

c. Description of each part.

d. Circuit reference designation, if applicable.

Table 6-1. Numerical List of Replaceable Parts

| HP PART NO. | DESCRIPTION | MFR CODE | MFR PART NO. | TQ |
|---|---|---|---|---|
| 0140-0191 | Capacitor, Fxd, Dipped Mica, 56 pf, 5% | 28480 | 0140-0191 | 1 |
| 0160-0153 | Capacitor, Fxd, My, 1000 pF, 10%, 200 VDCW | 56289 | 192P10292-PTS | 1 |
| 0160-0263 | Capacitor, Fxd, Cer, 0.22 uF, 20%, 50 VDCW | 56289 | 5C52BS-CML | 1 |
| 0160-2940 | Capacitor, Fxd, Mica, 470 pF, 5%, 300 VDCW | 72136 | RDM15F471J3C | 1 |
| 0180-0291 | Capacitor, Fxd, Elect, 1 uF, 10%, 35 VDCW | 56289 | 150D105X9035A2 | 17 |
| 0180-0338 | Capacitor, Fxd, Elect, 25 uF, +75, -10%, 25 VDCW | 28480 | 0180-0338 | 1 |
| 0410-0421 | Crystal, Quartz, 225.280 kHz, 0.01% | 28480 | 0410-0421 | 1 |
| 0698-0082 | Resistor, Fxd, Flm, 464 ohms, 1%, 1/8W | 28480 | 0698-0082 | 1 |
| 0698-0084 | Resistor, Fxd, Flm, 2.15k, 1%, 1/8W | 28480 | 0698-0084 | 3 |
| 0698-0085 | Resistor, Fxd, Flm, 2.61k, 1%, 1/8W | 28480 | 0698-0085 | 2 |
| 0698-0090 | Resistor, Fxd, Flm, 464 ohms, 1%, 1/2W | 28480 | 0698-0090 | 1 |
| 0698-3132 | Resistor, Fxd, Flm, 261 ohms, 1%, 1/8W | 28480 | 0698-3132 | 2 |
| 0698-3151 | Resistor, Fxd, Flm, 2.87k, 1%, 1/8W | 28480 | 0698-3151 | 1 |
| 0698-3152 | Resistor, Fxd, Flm, 3.48k, 1%, 1/8W | 28480 | 0698-3152 | 1 |
| 0698-3153 | Resistor, Fxd, Flm, 3.83k, 1%, 1/8W | 28480 | 0698-3153 | 1 |
| 0698-3154 | Resistor, Fxd, Flm, 4.22k, 1%, 1/8W | 28480 | 0698-3154 | 1 |
| 0698-3154** | Resistor, Fxd, Flm, 4.22k, 1%, 1/8W | 28480 | 0698-3154 | 1 |
| 0698-3155 | Resistor, Fxd, Flm, 4.64k, 1%, 1/8W | 28480 | 0698-3155 | 2 |
| 0698-3440 | Resistor, Fxd, Flm, 196 ohms, 1%, 1/8W | 28480 | 0698-3440 | 1 |
| 0698-3445 | Resistor, Fxd, Flm, 348 ohms, 1%, 1/8W | 28480 | 0698-3445 | 1 |
| 0698-3635 | Resistor, Fxd, Met Ox, 680 ohms, 5%, 2W | 28480 | 0698-3635 | 1 |
| 0757-0200 | Resistor, Fxd, Flm, 5.62k, 1%, 1/8W | 28480 | 0757-0200 | 2 |
| 0757-0274 | Resistor, Fxd, Flm, 1.21k, 1%, 1/8W | 28480 | 0757-0274 | 1 |
| 0757-0280 | Resistor, Fxd, Flm, 1k, 1%, 1/8W | 28480 | 0757-0280 | 4 |
| 0757-0394 | Resistor, Fxd, Flm, 51.1 ohms, 1%, 1/8W | 28480 | 0757-0394 | 1 |
| 0757-0421 | Resistor, Fxd, Flm, 825 ohms, 1%, 1/8W | 28480 | 0757-0421 | 1 |
| 0757-0427** | Resistor, Fxd, Flm, 1.5k, 1%, 1/8W | 28480 | 0757-0427 | 1 |
| 0757-0439 | Resistor, Fxd, Flm, 6.81k, 1%, 1/8W | 28480 | 0757-0439 | 1 |
| 0757-0442 | Resistor, Fxd, Flm, 10.0k, 1%, 1/8W | 28480 | 0757-0442 | 3 |
| 0757-0446* | Resistor, Fxd, Flm, 15.0k, 1%, 1/8W | 28480 | 0757-0446 | 1 |
| 0757-0461* | Resistor, Fxd, Flm, 68.1k, 1%, 1/8W | 28480 | 0757-0461 | 1 |
| 0757-1078 | Resistor, Fxd, Flm, 1.47k, 1%, 1/2W | 28480 | 0757-1078 | 1 |
| 0757-1094 | Resistor, Fxd, Flm, 1.47k, 1%, 1/8W | 28480 | 0757-1094 | 2 |
| 1200-0199 | Socket, Crystal | 28480 | 1200-0199 | 1 |
| 1810-0008 | Resistor, Network (6 fxd flm resistors) | 28480 | 1810-0008 | 1 |
| 1810-0020 | Resistor, Network (7 fxd flm resistors) | 28480 | 1810-0020 | 4 |
| 1820-0054 | Integrated Circuit, TTL | 01295 | SN4342 | 12 |
| 1820-0068 | Integrated Circuit, TTL | 12040 | SN7410N | 4 |
| 1820-0069 | Integrated Circuit, TTL | 01295 | SN4344 | 1 |
| 1820-0071 | Integrated Circuit, TTL | 01295 | SN7440N | 3 |
| 1820-0075 | Integrated Circuit, TTL | 01295 | SN4353 | 4 |
| 1820-0077 | Integrated Circuit, TTL | 01295 | SN4354 | 7 |
| 1820-0099 | Integrated Circuit | 01295 | SN7493N | 2 |
| 1820-0956 | Integrated Circuit, CTL | 07263 | SL3459 | 3 |
| 1820-0974 | Integrated Circuit, CTL | 07263 | SL4817 | 5 |
| 1853-0036 | Transistor, Si, PNP | 80131 | 2N3906 | 2 |
| 1853-0058 | Transistor, Si, PNP | 80131 | 2N3644 | 2 |
| 1854-0071 | Transistor, Si, NPN | 28480 | 1854-0071 | 3 |
| 1854-0094 | Transistor, Si, NPN | 80131 | 2N3646 | 3 |
| 1854-0215 | Transistor, Si, NPN | 80131 | 2N3904 | 2 |
| 1901-0460 | Diode, Si, 3 junction stabistor | 03508 | STB523 | 1 |
| 1902-0022 | Diode, Breakdown, 2.67V | 04713 | SZ10939-16 | 1 |
| 1910-0022 | Diode, Ge, 5 WIV | 14433 | G401 | 1 |
| 1910-0030 | Diode, Ge, 100 mA, 0.65V | 28480 | 1910-0030 | 4 |
| 8159-0005 | Jumper Wire | 28480 | 8159-0005 | 2 |
| 9140-0082 | Coil, Fxd, rf, 15 uH | 28480 | 9140-0082 | 2 |
| 12531-60022 | Buffered Teleprinter Card | 28480 | 12531-60022 | 1 |
| 12531-90033 | Buffered Teleprinter Manual | 28480 | 12531-90033 | 1 |

* Revision code 1117 only.
* Revision code 1120 only.

Table 6-2. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements.

| Code No. | Manufacturer | Address |
|---|---|---|
| 01295 | Texas Instruments, Inc., Transistor Products Div. | Dallas, Texas |
| 03508 | G.E. Semiconductor Prod. Dept. | Syracuse, N.Y. |
| 04713 | Motorola Inc. Semiconductor Prod. Div. | Phoenix, Arizona |
| 07263 | Fairchild Camera & Inst. Corp., Semiconductor Div. | Mountain View, Cal. |
| 12040 | National Semiconductor Corp. | Danbury, Conn. |
| 14433 | ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp. | West Palm Beach, Fla. |
| 28480 | Hewlett-Packard Co. | Palo Alto, Cal. |
| 56289 | Sprague Electric Co. | North Adams, Mass. |
| 72136 | Electro Motive Mfg. Co., Inc. | Williamantic, Conn. |
| 80131 | Electronic Industries Association. Standard tube or semi-conductor device, any manufacturer. | |

Table 6-3. Reference Designations and Abbreviations

## REFERENCE DESIGNATIONS

| | |
|---|---|
| A | = assembly |
| B | = motor, synchro |
| BT | = battery |
| C | = capacitor |
| CB | = circuit breaker |
| CR | = diode |
| DL | = delay line |
| DS | = indicator |
| E | = Misc electrical parts |
| F | = fuse |
| FL | = filter |
| J | = receptacle connector |
| K | = relay |
| L | = inductor |
| M | = meter |
| MC | = microcircuit |
| P | = plug connector |
| Q | = semiconductor device other than diode or microcircuit |
| R | = resistor |
| RT | = thermistor |
| S | = switch |
| T | = transformer |
| TB | = terminal board |
| TP | = test point |
| U | = integrated circuit, non-repairable assembly |
| V | = vacuum tube, photocell, etc. |
| VR | = voltage regulator |
| W | = cable, jumper |
| X | = socket |
| Y | = crystal |
| Z | = tuned cavity, network |

## ABBREVIATIONS

| | |
|---|---|
| A | = amperes |
| ac | = alternating current |
| ad | = anode |
| Al | = aluminum |
| AR | = as required |
| adj | = adjust |
| assy | = assembly |
| B | = base |
| bp | = bandpass |
| blk | = black |
| blu | = blue |
| brn | = brown |
| brs | = brass |
| Btu | = British thermal unit |
| Be Cu | = beryllium copper |
| C | = collector |
| cw | = clockwise |
| ccw | = counterclockwise |
| cer | = ceramic |
| cmo | = cabinet mount only |
| com | = common |
| crt | = cathode-ray tube |
| CTL | = complementary-transistor logic |
| cath | = cathode |
| cd pl | = cadmium plate |
| Comp | = composition |
| conn | = connector |
| compl | = complete |
| dc | = direct current |
| dr | = drive |
| DTL | = diode-transistor logic |
| depc | = deposited carbon |
| dpdt | = double-pole, double-throw |
| dpst | = double-pole, single-throw |
| E | = emitter |
| ECL | = emitter-coupled logic |
| ext | = external |
| encap | = encapsulated |
| elctlt | = electrolytic |
| F | = farads |
| FF | = flip-flop |
| flh | = flat head |
| Flm | = film |
| Fxd | = fixed |
| filh | = fillister head |
| G | = giga ($10^9$) |
| Ge | = germanium |
| gl | = glass |
| gnd | = ground(ed) |
| gra | = gray |
| grn | = green |
| H | = henries |
| Hg | = mercury |
| hr | = hour(s) |
| Hz | = hertz |
| hdw | = hardware |
| hex | = hexagon, hexagonal |
| ID | = inside diameter |
| IF | = intermediate frequency |
| in. | = inch, inches |
| I/O | = input/output |
| int | = internal |
| incl | = include(s) |
| insul | = insulation, insulated |
| impgrg | = impregnated |
| incand | = incandescent |
| k | = kilo ($10^3$), kilohm |
| lp | = low pass |
| m | = milli ($10^{-3}$) |
| M | = mega ($10^6$), megohm |
| My | = Mylar |
| mfr | = manufacturer |
| mom | = momentary |
| mtg | = mounting |
| misc | = miscellaneous |
| Met Ox | = metal oxide |
| mintr | = miniature |
| n | = nano ($10^{-9}$) |
| n.c. | = normally closed or no connection |
| Ne | = neon |
| no. | = number |
| n.o. | = normally open |
| np. | = nickel plated |
| NPN | = negative-positive-negative |
| NPO | = negative-positive zero (zero temperature coefficient) |
| NSR | = not separately replaceable |
| NRFR | = not recommended for field replacement |
| OD | = outside diameter |
| OBD | = order by description |
| orn | = orange |
| ovh | = oval head |
| oxd | = oxide |
| p | = pico ($10^{-12}$) |
| PC | = printed circuit |
| ph | = Phillips head |
| pk | = peak |
| p-p | = peak-to-peak |
| pt | = point |
| PIV | = peak inverse voltage |
| PNP | = positive-negative-positive |
| PWV | = peak working voltage |
| porc | = porcelain |
| posn | = position(s) |
| pozi | = pozidrive |
| rf | = radio frequency |
| rdh | = round head |
| rmo | = rack mount only |
| rms | = root-mean-square |
| RWV | = reverse working voltage |
| rect | = rectifier |
| r/min | = revolutions per minute |
| RTL | = resistor-transistor logic |
| s | = second |
| SB | = slow blow |
| Se | = selenium |
| Si | = silicon |
| scr | = silicon controlled rectifier |
| sil | = silver |
| sst | = stainless steel |
| stl | = steel |
| spcl | = special |
| spdt | = single-pole, double-throw |
| spst | = single-pole, single-throw |
| semicond | = semiconductor |
| Ta | = tantalum |
| td | = time delay |
| Ti | = titanium |
| tgl | = toggle |
| thd | = thread |
| tol | = tolerance |
| TTL | = transistor transistor logic |
| U($\mu$) | = micro ($10^{-6}$) |
| V | = volt(s) |
| var | = variable |
| vio | = violet |
| VDCW | = direct current working volts |
| W | = watts |
| WW | = wirewound |
| wht | = white |
| WIV | = working inverse voltage |
| yel | = yellow |

# SECTION VI

# REPLACEABLE PARTS

## 6-1. INTRODUCTION.

6-2. This section provides a replaceable parts cross reference between Teletype Corporation part numbers and Hewlett-Packard part numbers. Only parts with high usage rates have been assigned Hewlett-Packard part numbers; the corss reference (table 6-1) includes all parts currently in this category. Table 6-2 provides a list of reference designations and abbreviations encountered in this manual, and table 6-3 provides a manufacturers code list.

## 6-3. ORDERING INFORMATION.

6-4. All parts that have been assigned an HP part number may be ordered from the local Hewlett-Packard Sales and Service Office (addresses are given at the back of this manual). Teletype Corporation, Skokie, Illinois can supply all other parts.

6-5. When ordering parts from Hewlett-Packard, be sure to specify the following information for each part ordered:

a. Unit model number.

b. Unit serial number.

c. Hewlett-Packard stock number for each part.

d. Description of each part as listed in the Teletype Corporation manual supplied with the unit.

e. Circuit reference designation (if applicable).

Table 6-1. Replaceable Parts Cross Reference

| DESCRIPTION | TELETYPE PART NO. | HP PART NO. |
|---|---|---|
| Spring, Cover | 74709 | 1530-1531 |
| Spring, Expansion | 76422 | 1460-1196 |
| Spring, Expansion | 90615 | 1460-1194 |
| Spring, Expansion | 121100 | 1460-1195 |
| Shoe, Secondary Clutch | 150043 | 1530-1018 |
| Shoe, Primary Clutch | 150044 | 1530-1019 |
| Spring | 150241 | 1530-1020 |
| Oiler Felt, Function Bail | 150930 | 1530-1533 |
| Spring, Expansion | 151397 | 1460-1197 |
| Spring, Clutch | 151728 | 1530-1535 |
| Cover, Keyboard | 180027 | 1530-1431 |
| Spring, Multi-Tined | 180034 | 1460-1192 |
| Head, Print Hammer | 180502 | 1530-1010 |
| Spring | 180555 | 1530-1529 |
| Plate, Carriage Return Trip | 180571 | 1530-1534 |
| Lever, Shoe Release | 180646 | 1530-1016 |
| Knob, Range Adjust | 180654 | 1530-1015 |
| Brush, Carbon | 180979 | 1530-1013 |
| Disc, Distributor | 180987 | 1530-1014 |
| Bearing, Main Shaft | 181001 | 1530-1433 |
| Bearing, Main Shaft | 181002 | 1530-1434 |
| Shaft, Main Shaft | 181007 | 1530-1435 |
| Knob, Platen | 181039 | 1530-1003 |
| Holder, Paper | 181043 | 1530-1437 |
| Lid (w/window) | 181132 | 4040-0795 |
| Fan, Blower, 60 Hz | 181151 | 1530-1011 |
| Indicator, Elapsed Time, 60 Hz | 181265 | 1120-1534 |
| Indicator, Elapsed Time, 50 Hz | — | 1530-1289 |
| Spring | 181284 | 1530-1017 |
| Capacitor, Motor Start | 181384 | 1130-0811 |
| Belt, Drive | 181409 | 1530-1012 |
| Gear, Pinion | 181411 | 1530-1009 |
| Plate, Motor Gear | 181416 | 1530-1008 |
| Pulley, 100 WPM, 60 Hz | 181420 | 1530-1007 |
| Knob, Line/Local Switch | 181824 | 1530-1002 |
| Plate, Mounting, 50 Hz | 181850 | 1530-1213 |
| Gear, 17 Tooth, 50 Hz | 181851 | 1530-1214 |
| Pulley, 100 WPM, 50 Hz | 181855 | 1530-1215 |
| Motor, Drive, 60 Hz | 181870 | 1530-0996 |
| Transformer, 50 Hz | 181878 | 1530-1216 |
| Transformer, 50 Hz | 181879 | 1530-1217 |
| Fan, Blower, 50 Hz | 182181 | 1530-1218 |

Table 6-1. Replaceable Parts Cross Reference (Continued)

| DESCRIPTION | TELETYPE PART NO. | HP PART NO. |
|---|---|---|
| Deflector, Fan (50 Hz units) | 182183 | 1530-1219 |
| Motor, Drive, 50 Hz | 182267 | 1530-1212 |
| Lid, Punch Unit | 182912 | 4040-0796 |
| Holder, Paper Tape | 182918 | 1530-1436 |
| Cover, Left, Punch | 182922 | 4040-0794 |
| Latch, Spring | 183029 | 1530-1005 |
| Lid, Reader Unit | 183032 | 1530-1530 |
| Bail, Tight Tape | 183033 | 1530-1004 |
| Cover, Contact | 183062 | 1535-0029 |
| Wheel, Feed | 183071 | 1530-1006 |
| Scr., Fil. Hd., 4-40 x 9/64 | 183112 | 2200-0764 |
| Cover, Tape Reader | 183135 | 4040-0827 |
| Guide, Line | 183254 | 1535-0030 |
| Scr., Self-Tapping, No. 8 | 183261 | 0624-0274 |
| Scr., Thumb, 8-32 | 184085 | 0570-1123 |
| Drum, Answer Back | 184149 | 1530-1532 |
| Scr., Self-Tapping, 1/4 - 14 | 192289 | 0624-0273 |
| Reader (w/Harness) | UX800 | 1535-0036 |
| Fuse, 2A, Slo Blo | — | 2110-0303 |
| Fuse, 3A, Slo Blo | — | 2110-0029 |
| Fuse, 3/8A, Slo Blo | — | 2110-0044 |
| Fuse, 1/2A, Slo Blo | — | 2110-0008 |
| Fuse, 1.8A, Slo Blo | — | 2110-0353 |
| Kit, Overhaul | — | 5080-5376 |
| Includes all parts in 3000 hr maintenance kit and the following parts | | |
| Bearing, Ball (2) | 180467 | |
| Bearing, Ball (4) | 180468 | |
| Bearing, Ball (1) | 180575 | |
| Bearing, Ball (1) | 180576 | |
| Lever, Blocking (4) | 180643 | |
| Lever, Blocking (4) | 180644 | |
| Lever, Selector (8) | 180645 | |
| Lever, Lock (1) | 180669 | |
| Lever, Start W/Stud (1) | 180671 | |
| Armature Assembly (1) | 180704 | |
| Bearing (1) | 180969 | |
| Bearing (1) | 180970 | |
| Disc, Distributor (1) | 180987 | 1530-1014 |
| Bearing (1) | 181001 | 1530-1433 |
| Bearing (1) | 181002 | 1530-1434 |
| Plate W/Stud (1) | 181416 | 1530-1008 |
| Pulley & Gear W/insert, 100 WPM (1) | 181420 | 1530-1007 |

Table 6-1. Replaceable Parts Cross Reference (Continued)

| DESCRIPTION | TELETYPE PART NO. | HP PART NO. |
|---|---|---|
| Kit, 3000 hr maintenance | — | 5080-5377 |
| Includes following parts: | | |
| Rail, Carriage (1) | 185799 | |
| Block, Rotary Drive (2) | 180471 | |
| Guide, Nylon (6) | 180478 | |
| Head, Print Hammer (1) | 180502 | 1530-1010 |
| Plate, W/Post (1) | 180505 | |
| Plate, W/Post (1) | 180506 | |
| Slide (Common) (1) | 180510 | |
| Slide (2) | 180511 | |
| Slide W/Plates (1) | 180512 | |
| Plate (1) | 180518 | |
| Rack (2) | 180519 | |
| Bail, Carriage Drive (1) | 180544 | |
| Bracket (1) | 180549 | |
| Shaft (2) | 180920 | |
| Bar, Code – (PS) | 180947 | |
| Brush, Carbon (2) | 180979 | 1530-1013 |
| Pawl, Feed (1) | 181067 | |
| Ratchet, Left W/Pin (1) | 181125 | |
| Ratchet, Right W/Pin (1) | 181126 | |
| Belt, Timing (1) | 181409 | 1530-1012 |
| Bar, Code & Blocking Lever (8-1) (1) | 186282 | |
| Bar, Code & Blocking Lever (8-2) (1) | 186283 | |
| Bar, Code & Blocking Lever (8-3) (1) | 186284 | |
| Bar, Code & Blocking Lever (8-4) (1) | 186285 | |
| Bar, Code & Blocking Lever (8-5) (1) | 186286 | |
| Bar, Code & Blocking Lever (8-6) (1) | 186287 | |
| Bar, Code & Blocking Lever (8-7) (1) | 186288 | |
| Bar, Code & Blocking Lever (8-8) (1) | 186289 | |
| Blocking Lever (4) | 180643 | |
| Blocking Lever (4) | 180644 | |
| Kit, Lubrication | — | 5080-6610 |
| Includes following: | | |
| Accessory brush | — | 9300-0082 |
| No. 2 Brush | — | 8520-0005 or 8520-0015 |
| Applicator | — | 8710-0001 |
| Polyethylene bag (4 x 2 x 4) | — | 9220-0006 |
| Polyethylene bag (6 x 3 x 12) | — | 9220-0001 |
| Moly lube | — | 6040-0012 |
| Grease | KS7471 | 6040-0074 |

Table 6-1. Replaceable Parts Cross Reference (Continued)

| DESCRIPTION | TELETYPE PART NO. | HP PART NO. |
|---|---|---|
| Teletype oil kit | — | 5080-6614 |
| Oil | KS7470 | 6040-0075 |
| Bottle with dropper | — | 1540-0084 |
| Bottle cap | — | 9300-0343 |
| Cardboard box | — | 9211-0022 |
| Label | — | 7120-1947 |
| Maintenance Tools: | | |
| Hook, Spring Pull | 75765 | 1530-1438 |
| Hook, Spring Pull | 142554 | 1530-1439 |
| Hook, Spring Push | 142555 | 1530-1440 |
| Tweezers | 151392 | 1530-1441 |
| Gauge Set | 117781 | 1530-1442 |
| Gauge Case for above | 117375 | 1530-1443 |
| Gauge Holder for below | 93814 | 1530-1444 |
| Gauge Set | 93809 | 1530-1445 |
| Gauge Set | 179411 | 1530-1446 |
| Handwheel | 161430 | 1530-1447 |
| w/screw | 94540 | |
| Handwheel Adapter | 181465 | 1530-1448 |
| w/screw | 94540 | |
| Bender, Spring | 110445 | 1530-1449 |
| Gauge, Tape | 95960 | 1530-1450 |
| Wrench, Open End 1/4 in. | 125777 | 1530-1451 |
| Tool, Typewheel Adj | 180588 | 1530-1453 |

Table 6-2. Reference Designations and Abbreviations

## REFERENCE DESIGNATIONS

| | | | | | |
|---|---|---|---|---|---|
| A | = assembly | K | = relay | TB | = terminal board |
| B | = motor | L | = inductor | TP | = test point |
| BT | = battery | M | = meter | U | = integrated circuit |
| C | = capacitor | MC | = microcircuit | V | = vacuum tube, neon bulb, photocell, etc. |
| CR | = diode | P | = plug connector | | |
| DL | = delay line | Q | = transistor | VR | = voltage regulator |
| DS | = indicator (lamp) | R | = resistor | W | = cable, jumper |
| E | = misc hardware | RT | = thermistor | X | = socket |
| F | = fuse | S | = switch | Y | = crystal |
| FL | = filter | T | = transformer | Z | = tuned cavity, network |
| J | = receptacle connector | | | | |

## ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| A | = amperes | gnd | = ground(ed) | ph | = Phillips head |
| ac | = alternating current | gra | = gray | pk | = peak |
| ad | = anode | grn | = green | p-p | = peak-to-peak |
| Al | = aluminum | | | pt | = point |
| AR | = as required | H | = henries | PIV | = peak inverse voltage |
| adj | = adjust | Hg | = mercury | PNP | = positive-negative-positive |
| Assy | = assembly | hr | = hour(s) | PWV | = peak working voltage |
| | | Hz | = hertz | porc | = porcelain |
| B | = base | hdw | = hardware | posn | = position(s) |
| bp | = bandpass | hex | = hexagon, hexagonal | pozi | = pozidrive |
| bfo | = beat frequency oscillator | | | ph brz | = phosphor bronze |
| blk | = black | ID | = inside diameter | | |
| blu | = blue | IF | = intermediate frequency | rf | = radio frequency |
| brn | = brown | in. | = inch, inches | rdh | = round head |
| brs | = brass | I/O | = input/output | rmo | = rack mount only |
| Btu | = British thermal unit | int | = internal | rms | = root-mean-square |
| bwo | = backward wave oscillator | incl | = include(s) | RWV | = reverse working voltage |
| Be Cu | = beryllium copper | insul | = insulation, insulated | rect | = rectifier |
| | | impgnt | = impregnated | r/min | = revolutions per minute |
| C | = collector | incand | = incandescent | | |
| cw | = clockwise | | | s | = second |
| ccw | = counterclockwise | k | = kilo ($10^3$), kilohm | SB | = slow-blow |
| cer | = ceramic | | | Se | = selenium |
| cmo | = cabinet mount only | lp | = low pass | Si | = silicon |
| com | = common | | | scr | = silicon-controlled rectifier |
| crt | = cathode-ray tube | m | = milli ($10^{-3}$) | sil | = silver |
| CTL | = capacitor-transistor logic | M | = mega ($10^6$), megohm | sst | = stainless steel |
| cath | = cathode | My | = Mylar | stl | = steel |
| cd pl | = cadmium plate | mfr | = manufacturer | spcl | = special |
| Comp | = composition | mom | = momentary | spdt | = single-pole, double-throw |
| conn | = connector | mtg | = mounting | spst | = single-pole, single-throw |
| compl | = complete | misc | = miscellaneous | semicond | = semiconductor |
| | | met ox | = metal oxide | | |
| dc | = direct current | mintr | = miniature | Ta | = tantalum |
| dr | = drive | | | td | = time delay |
| DTL | = diode-transistor logic | n | = nano ($10^{-9}$) | Ti | = titanium |
| depc | = deposited carbon | nc | = normally closed or no connection | tgl | = toggle |
| dpdt | = double-pole, double-throw | | | thd | = thread |
| dpst | = double-pole, single-throw | Ne | = neon | tol | = tolerance |
| | | no. | = number or normally open | TTL | = transistor-transistor logic |
| E | = emitter | np | = nickel plated | term | = terminal |
| ext | = external | NPN | = negative-positive-negative | | |
| encap | = encapsulated | NPO | = negative positive zero (zero temperature coefficient) | U ($\mu$) | = micro ($10^{-6}$) |
| elctlt | = electrolytic | NSR | = not separately replaceable | V | = volt(s) |
| | | NRFR | = not recommended for field replacement | var | = variable |
| F | = farads | | | vio | = violet |
| FF | = flip-flop | | | VDCW | = direct current working volts |
| flh | = flat head | OD | = outside diameter | | |
| flm | = film | OBD | = order by description | W | = watts |
| fxd | = fixed | orn | = orange | ww | = wirewound |
| filh | = fillister head | ovh | = oval head | wht | = white |
| | | oxd | = oxide | WIV | = working inverse voltage |
| G | = giga ($10^9$) | | | | |
| Ge | = germanium | p | = pico ($10^{-12}$) | yel | = yellow |
| gl | = glass | PC | = printed circuit | | |

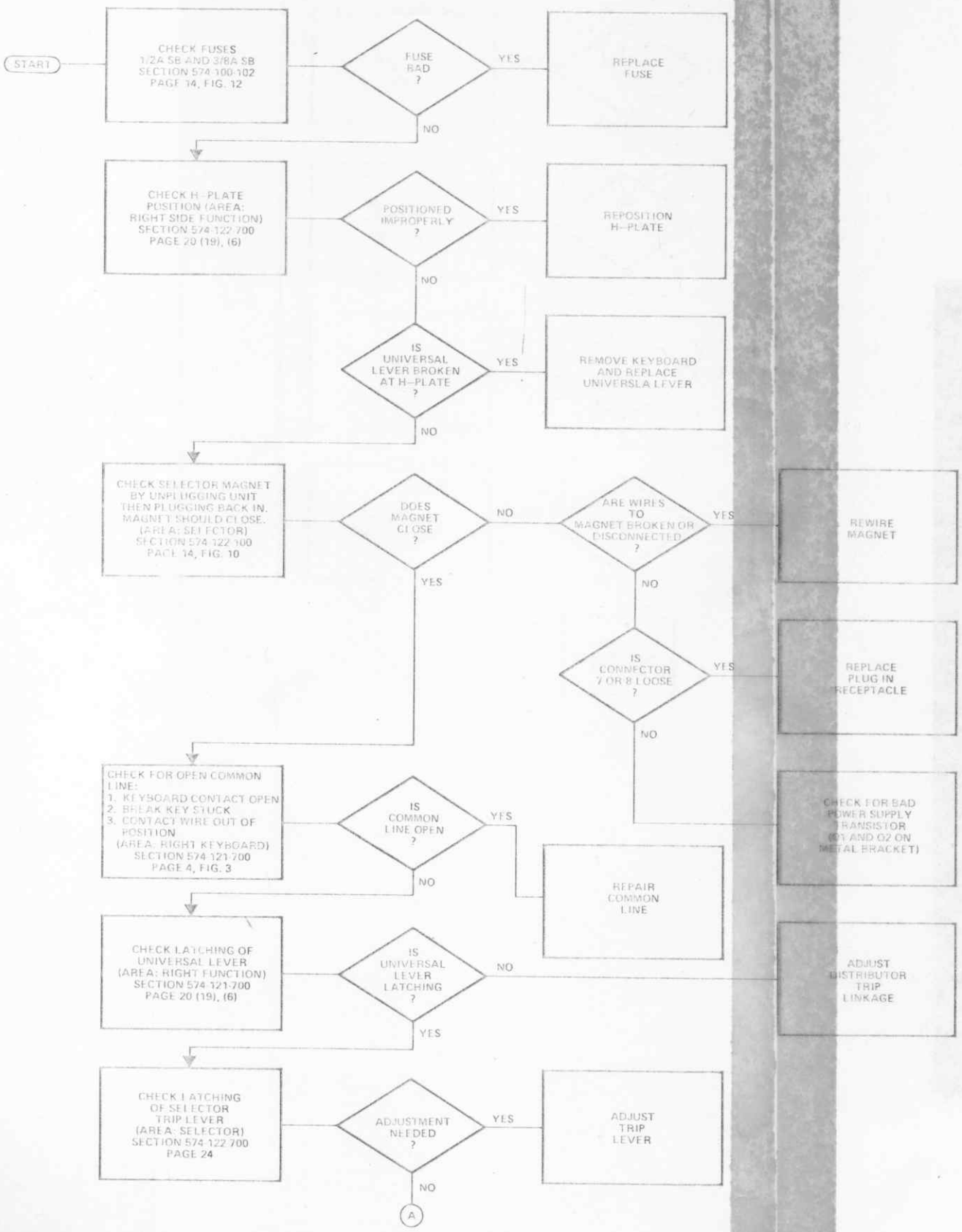
## Table 6-3. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

| Code No. | Manufacturer | Address |
|---|---|---|
| 00000 | U.S.A Common | Any supplier of U.S. |
| 00136 | McCoy Electronics | Mount Holly Springs, Pa. |
| 00213 | Sage Electronics Corp. | Rochester, N.Y. |
| 00287 | Cemco, Inc. | Danielson, Conn. |
| 00334 | Humidial | Colton, Calif. |
| 00348 | Mictron, Co., Inc. | Valley Stream, N.Y. |
| 00373 | Garlock Inc. | Cherry Hill, N.J. |
| 00656 | Aerovox Corp. | New Bedford, Mass. |
| 00779 | Amp, Inc. | Harrisburg, Pa. |
| 00781 | Aircraft Radio Corp. | Boonton, N.J. |
| 00809 | Croven, Ltd. | Whitby, Ontario, Canada |
| 00815 | Northern Engineering Laboratories, Inc. | Burlington, Wis. |
| 00853 | Sangamo Electric Co., Pickens Div. | Pickens, S.C. |
| 00866 | Goe Engineering Co. | City of Industry, Cal. |
| 00891 | Carl E. Holmes Corp. | Los Angeles, Cal. |
| 00929 | Microlab Inc. | Livingston, N.J. |
| 01002 | General Electric Co., Capacitor Dept. | Hudson Falls, N.Y. |
| 01009 | Alden Products Co. | Brockton, Mass. |
| 01121 | Allen Bradley Co. | Milwaukee, Wis. |
| 01255 | Litton Industries, Inc. | Beverly Hills, Cal. |
| 01281 | TRW Semiconductors, Inc. | Lawndale, Cal. |
| 01295 | Texas Instruments, Inc., Transistor Products Div. | Dallas, Texas |
| 01349 | The Alliance Mfg. Co | Alliance, Ohio |
| 01538 | Small Parts Inc. | Los Angeles, Cal. |
| 01589 | Pacific Relays, Inc. | Van Nuys, Cal. |
| 01670 | Gudebrod Bros. Silk Co. | New York, N.Y. |
| 01930 | Amerock Corp. | Rockford, Ill. |
| 01960 | Pulse Engineering Co | Santa Clara, Cal. |
| 02114 | Ferroxcube Corp. of America | Saugerties, N.Y. |
| 02116 | Wheelock Signals, Inc. | Long Branch, N.J. |
| 02286 | Cole Rubber and Plastics Inc | Sunnyvale, Cal. |
| 02660 | Amphenol-Borg Electronics Corp. | Broadview, Ill. |
| 02735 | Radio Corp. of America, Semiconductor and Materials Division | Somerville, N.J. |
| 02771 | Vocaline Co. of America, Inc. | Old Saybrook, Conn. |
| 02777 | Hopkins Engineering Co. | San Fernando, Cal. |
| 02875 | Hudson Tool & Die | Newark, N.J. |
| 03296 | Nylon Molding Corp. | Springfield, N.J. |
| 03508 | G.E. Semiconductor Prod. Dept. | Syracuse, N.Y. |
| 03705 | Apex Machine & Tool Co. | Dayton, Ohio |
| 03797 | Eldema Corp. | Compton, Calif. |
| 03818 | Parker Seal Co. | Los Angeles, Cal. |
| 03877 | Transitron Electric Corp. | Wakefield, Mass. |
| 03888 | Pyrofilm Resistor Co., Inc. | Cedar Knolls, N.J. |
| 03954 | Singer Co., Diehl Div., Finderne Plant | Sumerville, N.J. |
| 04009 | Arrow, Hart and Hegeman Elect. Co. | Hartford, Conn. |
| 04013 | Taruus Corp. | Lambertville, N.J. |
| 04062 | Arco Electronic Inc. | Great Neck, N.Y. |
| 04217 | Essex Wire | Los Angeles, Cal. |
| 04222 | Hi-Q Division of Aerovox | Myrtle Beach, S.C. |
| 04354 | Precision Paper Tube Co. | Wheeling, Ill |
| 04404 | Palo Alto Division of Hewlett-Packard Co. | Palo Alto, Cal. |
| 04651 | Sylvania Electric Products, Microwave Device Div. | Mountain View, Cal. |
| 04673 | Dakota Engr. Inc. | Culver City, Cal. |
| 04713 | Motorola Inc. Semiconductor Prod. Div. | Phoenix, Arizona |
| 04732 | Filtron Co., Inc. Western Div. | Culver City, Cal. |
| 04773 | Automatic Electric Co. | Northlake, Ill. |
| 04796 | Sequoia Wire Co. | Redwood City, Cal. |
| 04811 | Precision Coil Spring Co. | El Monte, Cal. |
| 04870 | P.M. Motor Company | Westchester, Ill. |
| 04919 | Component Mfg. Service Co. | W. Bridgewater, Mass. |
| 05006 | Twentieth Century Plastics, Inc. | Los Angeles, Cal. |
| 05277 | Westinghouse Electric Corp. Semiconductor Dept. | Youngwood, Pa. |
| 05347 | Ultronix, Inc. | San Mateo, Cal. |
| 05397 | Union Carbine Corp., Elect. Div. | New York, N.Y. |
| 05574 | Viking Ind Inc. | Canoga Park, Cal. |
| 05593 | Icore Electro-Plastics Inc. | Sunnyvale, Cal. |
| 05616 | Cosmo Plastic (c/o Electrical Spec Co.) | Cleveland, Ohio |
| 05624 | Barber Colman Co. | Rockford, Ill. |
| 05728 | Tiffen Optical Co. | Roslyn Heights, Long Island, N.Y. |
| 05729 | Metro-Tel Corp. | Westbury, N.Y. |
| 05783 | Stewart Engineering Co. | Santa Cruz, Cal. |
| 05820 | Wakefield Engineering Inc. | Wakefield, Mass. |
| 06004 | Bassick Co., Div. of Stewart Warner Corp. | Bridgeport, Conn. |
| 06090 | Raychem Corp. | Redwood City, Cal. |
| 06175 | Bausch and Lomb Optical Co. | Rochester, N.Y. |
| 06402 | E.T.A. Products Co. of America | Chicago, Ill. |
| 06540 | Amatom Electronic Hardware Co., Inc. | New Rochelle, N.Y. |
| 06555 | Beede Electrical Instrument Co., Inc. | Penacook, N.H. |
| 06666 | General Devices Co., Inc. | Indianapolis, Ind. |
| 06751 | Components Inc., Ariz. Div. | Phoenix, Arizona |
| 06812 | Torrington Mfg. Co., West Div. | Van Nuys, Cal. |
| 06980 | Varian Assoc. Eimac Div. | San Carlos, Cal. |
| 07088 | Kelvin Electric Co. | Van Nuys, Cal. |
| 07126 | Digitran Co. | Pasadena, Cal. |
| 07137 | Transistor Electronics Corp. | Minneapolis, Minn. |
| 07138 | Westinghouse Electric Corp., Electronic Tube Div. | Elmira, N.Y. |
| 07149 | Filmohm Corp. | New York, N.Y. |
| 07233 | Cinch-Graphik Co. | City of Industry, Cal. |
| 07256 | Silicon Transistor Corp. | Carle Place, N.Y. |
| 07261 | Avnet Corp. | Culver City, Cal. |
| 07263 | Fairchild Camera & Inst. Corp., Semiconductor Div. | Mountain View, Cal. |
| 07322 | Minnesota Rubber Co. | Minneapolis, Minn. |
| 07387 | Birtcher Corp, The | Monterey Park, Cal. |
| 07397 | Sylvania Elect. Prod. Inc., Mt. View Operations | Mountain View, Cal. |
| 07700 | Technical Wire Products Inc. | Cranford, N.J. |
| 07829 | Bodine Elect. Co. | Chicago, Ill. |
| 07910 | Continental Device Corp. | Hawthorne, Cal. |
| 07933 | Raytheon Mfg. Co., Semiconductor Div. | Mountain View, Cal. |
| 07980 | Hewlett-Packard Co., New Jersey Division | Rockaway, N.J. |
| 08145 | U.S. Engineering Co. | Los Angeles, Cal. |
| 08289 | Blinn, Delbert Co. | Pomona, Cal. |
| 08358 | Burgess Battery Co. | Niagara Falls, Ontario, Canada |
| 08524 | Deutsch Fastener Corp. | Los Angeles, Cal. |
| 08664 | Bristol Co., The | Waterbury, Conn |
| 08717 | Sloan Company | Sun Valley, Cal. |
| 08718 | ITT Cannon Electric Inc., Phoenix Div. | Phoenix, Arizona |
| 08727 | National Radio Lab. Inc. | Paramus, N.J. |
| 08792 | CBS Electronics Semiconductor Operations, Div. of CBS Inc | Lowell, Mass. |
| 08806 | General Electric Co., Miniature Lamp Dept. | Cleveland, Ohio |
| 08984 | Mel-Rain | Indianapolis, Ind. |
| 09026 | Babcock Relays Div. | Costa Mesa, Cal. |
| 09097 | Electronic Enclosures Inc. | Los Angeles, Calif. |
| 09134 | Texas Capacitor Co. | Houston, Texas |
| 09145 | Tech. Ind. Inc. Atohm Elect. | Burbank, Cal. |
| 09250 | Electro Assemblies, Inc. | Chicago, Ill. |
| 09353 | C & K Components Inc. | Newton, Mass. |
| 09569 | Mallory Battery Co. of Canada, Ltd. | Toronto, Ontario, Canada |
| 09795 | Pennsylvania Florocarbon. | Clifton Heights, Penn. |
| 09922 | Burndy Corp. | Norwalk, Conn. |
| 10214 | General Transistor Western Corp. | Los Angeles, Cal. |
| 10411 | Ti-Tal, Inc, | Berkeley, Cal. |
| 10646 | Carborundum Co. | Niagara Falls, N.Y. |
| 11236 | CTS of Berne, Inc. | Berne, Ind. |
| 11237 | Chicago Telephone of California, Inc. | So. Pasadena, Cal. |
| 11242 | Bay State Electronics Corp. | Waltham, Mass. |
| 11312 | Teledyne Inc., Microwave Div. | Palo Alto, Cal. |
| 11314 | National Seal | Downey, Cal. |
| 11453 | Precision Connector Corp. | Jamaica, N.Y. |
| 11534 | Duncan Electronics Inc. | Costa Mesa, Cal. |
| 11711 | General Instrument Corp., Semiconductor Division Products Group | Newark, N.J. |
| 11717 | Imperial Electronic, Inc. | Buena Park, Cal. |
| 11870 | Melabs, Inc. | Palo Alto, Cal. |
| 12136 | Philadelphia Handle Co. | Camden, N.J. |
| 12361 | Grove Mfg. Co., Inc. | Shady Grove, Pa. |
| 12574 | Gulton Ind. Inc., Data System Div. | Albuquerque, N.M. |
| 12697 | Clarostat Mfg. Co. | Dover, N.H. |
| 12728 | Elmar Filter Corp | W. Haven, Conn. |
| 12859 | Nippon Electric Co., Ltd. | Tokyo, Japan |
| 12881 | Metex Electronics Corp. | Clark, N.J. |
| 12930 | Delta Semiconductor Inc. | Newport Beach, Cal. |
| 12954 | Dickson Electronics Corp. | Scottsdale, Arizona |
| 13019 | Airco Supply Co., Inc. | Witchita, Kansas |
| 13061 | Wilco Products | Detroit, Mich. |
| 13103 | Thermolloy | Dallas, Texas |
| 13327 | Solitron Devices Inc. | Tappan, N.Y. |
| 13396 | Telefunken (GmbH) | Hanover, Germany |
| 13835 | Midland-Wright Div. of Pacific Industries, Inc. | Kansas City, Kansas |
| 14099 | Sem-Tech | Newbury Park, Cal. |
| 14193 | Calif. Resistor Corp | Santa Monica, Cal. |
| 14298 | American Components, Inc. | Conshohocken, Pa. |
| 14433 | ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation | West Palm Beach, Fla. |
| 14493 | Hewlett-Packard Company | Loveland, Colo. |
| 14655 | Cornell Dubilier Electric Corp | Newark, N.J. |
| 14674 | Corning Glass Works | Corning, N.Y. |
| 14752 | Electro Cube Inc | San Gabriel, Cal. |
| 14960 | Willamette Mfg. Co. | San Jose, Cal. |
| 15106 | The Sphere Co., Inc. | Little Falls, N.J. |
| 15203 | Webster Electronics Co. | New York, N.Y. |
| 15287 | Scionics Corp. | Northridge, Cal. |
| 15291 | Adjustable Bushing Co. | N. Hollywood, Cal. |
| 15558 | Micron Electronics | Garden City, Long Island, N.Y. |
| 15566 | Amprobe Inst. Corp. | Lynbrook, N.Y. |
| 15631 | Cabletronics | Costa Mesa, Cal. |
| 15772 | Twentieth Century Coil Spring Co. | Santa Clara, Cal. |
| 15801 | Fenwal Elect. Inc. | Framingham, Mass. |
| 15818 | Amelco Inc. | Mountain View, Cal. |
| 16037 | Spruce Pine Mica Co. | Spruce Pine, N.C. |
| 16179 | Omni Spectra Inc. | Detroit, Ill. |
| 16352 | Computer Diode Corp. | Lodi, N.J. |
| 16554 | Electroid Co. | Union, N.J. |
| 16585 | Boots Aircraft Nut Corp. | Pasadena, Cal. |
| 16688 | Ideal Prec. Meter Co., Inc., De Jur Meter Div. | Brooklyn, N.Y. |
| 16758 | Delco Radio Div. of G.M. Corp. | Kokomo, Ind. |
| 17109 | Thermonetics Inc. | Canoga Park, Cal. |
| 17474 | Tranex Company | Mountain View, Cal. |
| 17675 | Hamlin Metal Products Corp. | Akron, Ohio |
| 17745 | Angstrohm Prec. Inc. | No. Hollywood, Cal. |
| 17856 | Siliconix Inc. | Sunnyvale, Cal. |
| 17870 | McGraw-Edison Co. | Manchester, N.H. |
| 18042 | Power Design Pacific Inc | Palo Alto, Cal. |
| 18083 | Clevite Corp. Semiconductor Div. | Palo Alto, Cal. |
| 18324 | Signetics Corp. | Sunnyvale, Cal. |
| 18476 | Ty-Car Mfg. Co., Inc. | Holliston, Mass. |
| 18486 | TRW Elect. Comp. Div. | Des Plaines, Ill. |
| 18565 | Chomerics | Plainville, Mass. |
| 18583 | Curtis Instrument, Inc. | Mt. Kisco, N.Y. |
| 18612 | Vishay Instruments Inc. | Malvern, Pa. |
| 18873 | E.I. DuPont and Co., Inc. | Wilmington, Del. |
| 18911 | Durant Mfg. Co. | Milwaukee, Wis. |
| 19315 | The Bendix Corp., Navigation & Control Div. | Teterboro, N.J. |
| 19500 | Thomas A. Edison Industries, Div. of McGraw-Edison | West Orange, N.J. |
| 19589 | Concoa | Baldwin Park, Cal. |

00015-49
Revised: May, 1970

From: Handbook Supplements
H4-1 Dated January 1970


START
CHECK FUSES 1/2A SB AND 3/8A SB SECTION 574-100-102 PAGE 14, FIG. 12
FUSE BAD ?
YES
REPLACE FUSE
NO
CHECK H-PLATE POSITION (AREA: RIGHT SIDE FUNCTION) SECTION 574-122-700 PAGE 20 (19), (6)
POSITIONED IMPROPERLY ?
YES
REPOSITION H-PLATE
NO
IS UNIVERSAL LEVER BROKEN AT H-PLATE ?
YES
REMOVE KEYBOARD AND REPLACE UNIVERSLA LEVER
NO
CHECK SELECTOR MAGNET BY UNPLUGGING UNIT THEN PLUGGING BACK IN. MAGNET SHOULD CLOSE. (AREA: SELECTOR) SECTION 574-122-700 PAGE 14, FIG. 10
DOES MAGNET CLOSE ?
NO
ARE WIRES TO MAGNET BROKEN OR DISCONNECTED ?
YES
REWIRE MAGNET
NO
YES
IS CONNECTOR 7 OR 8 LOOSE ?
YES
REPLACE PLUG IN RECEPTACLE
NO
CHECK FOR OPEN COMMON LINE:
1. KEYBOARD CONTACT OPEN
2. BREAK KEY STUCK
3. CONTACT WIRE OUT OF POSITION
(AREA: RIGHT KEYBOARD) SECTION 574-121-700 PAGE 4, FIG. 3
IS COMMON LINE OPEN ?
YES
REPAIR COMMON LINE
NO
CHECK FOR BAD POWER SUPPLY TRANSISTOR (Q1 AND Q2 ON METAL BRACKET)
CHECK LATCHING OF UNIVERSAL LEVER (AREA: RIGHT FUNCTION) SECTION 574-121-700 PAGE 20 (19), (6)
IS UNIVERSAL LEVER LATCHING ?
NO
ADJUST DISTRIBUTOR TRIP LINKAGE
YES
CHECK LATCHING OF SELECTOR TRIP LEVER (AREA: SELECTOR) SECTION 574-122-700 PAGE 24
ADJUSTMENT NEEDED ?
YES
ADJUST TRIP LEVER
NO
A

2089-15

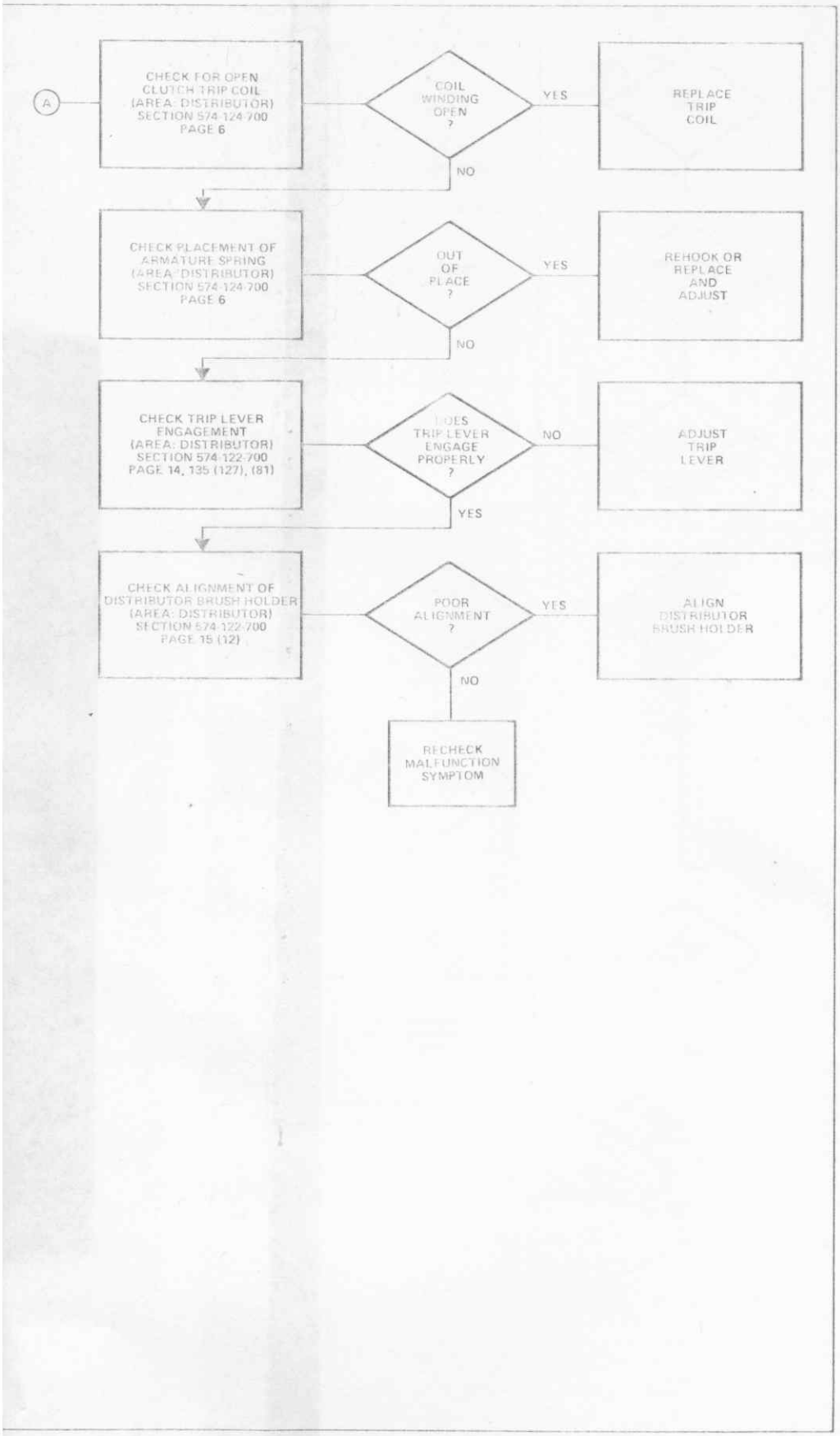
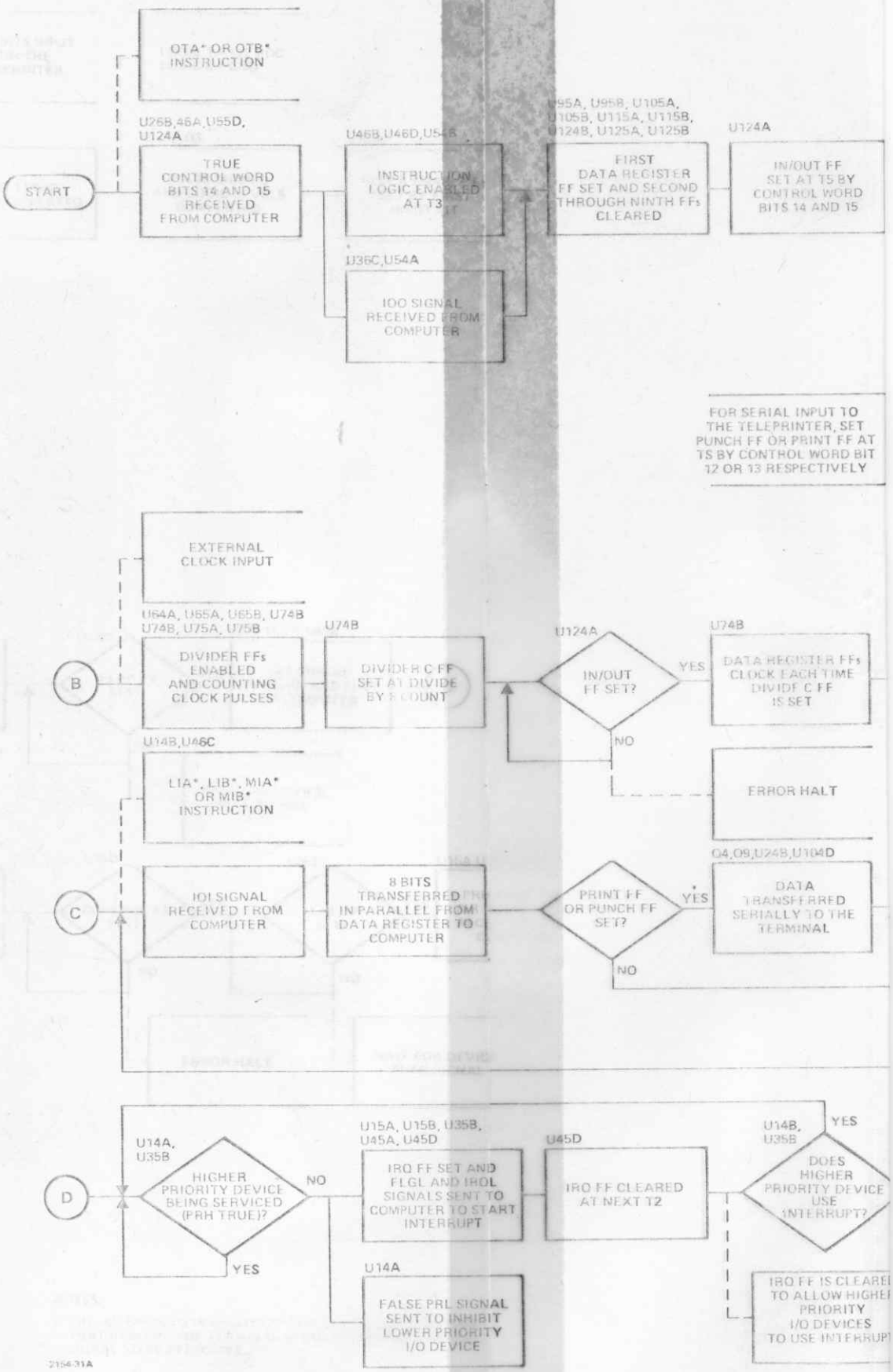
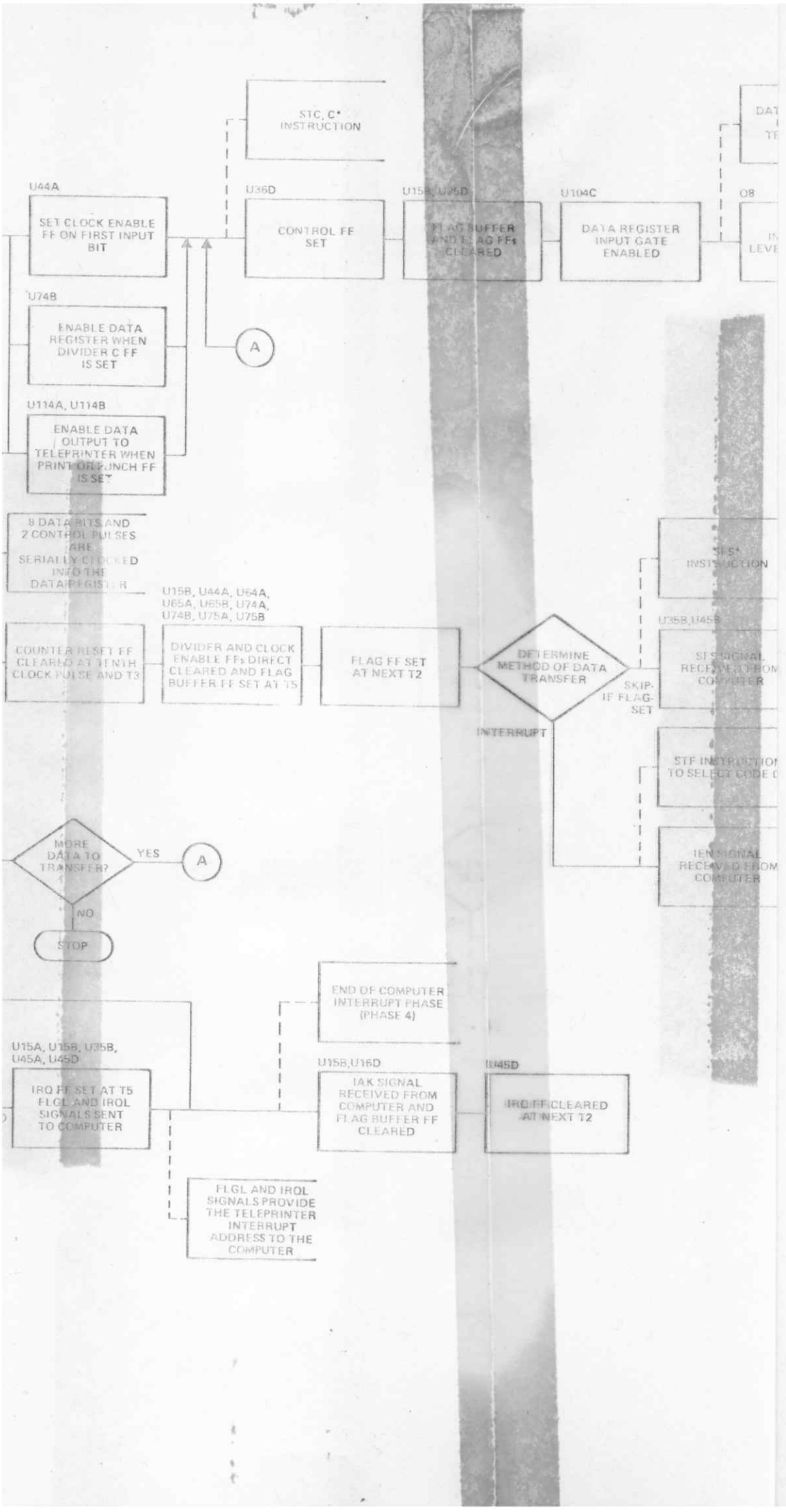
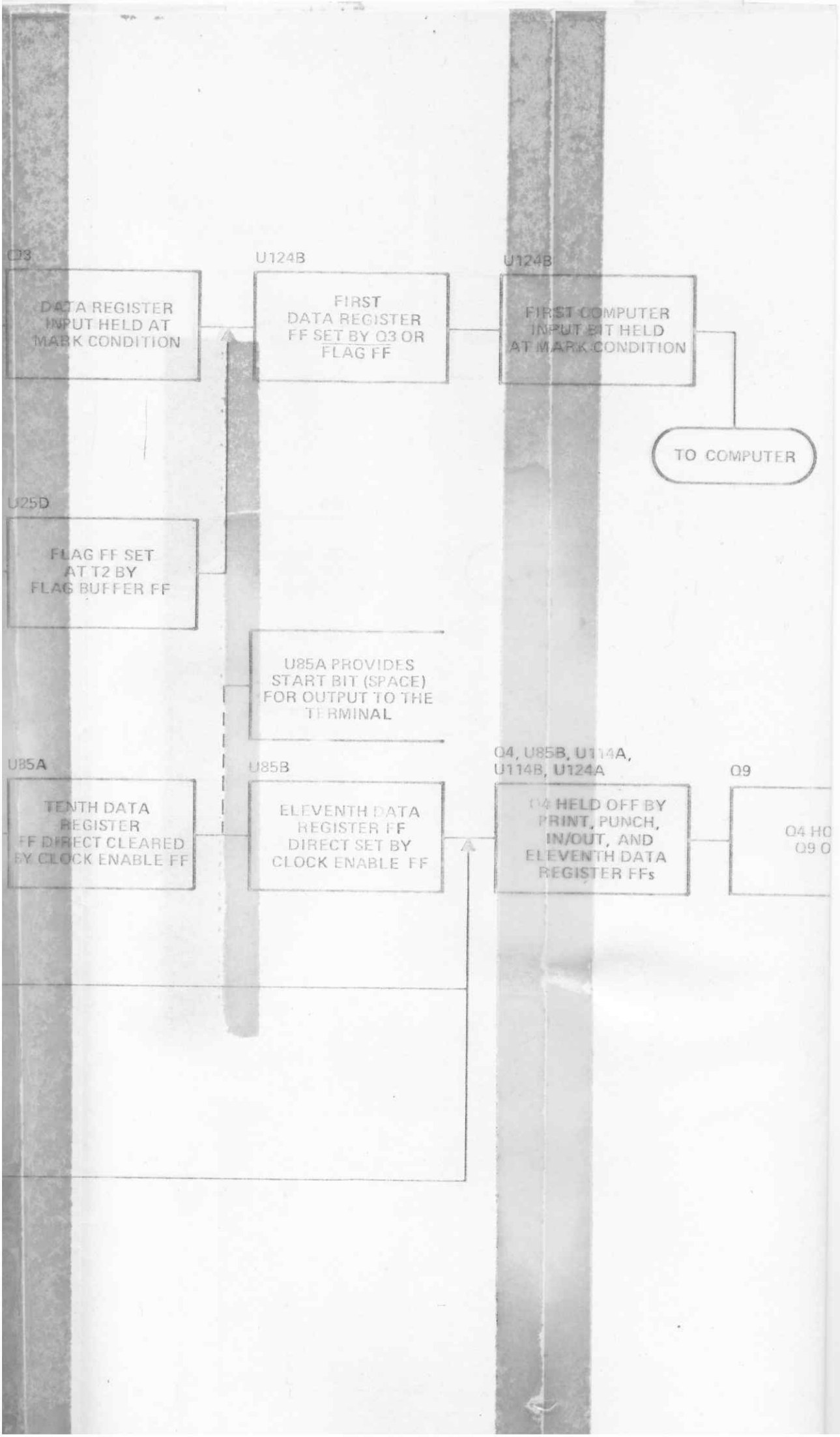



Figure 5-11. Troubleshooting Flowchart, Runs Open (LOCAL Position) with Selector Open


OTA* OR OTB* INSTRUCTION
U26B,46A,U55D, U124A
START
TRUE CONTROL WORD BITS 14 AND 15 RECEIVED FROM COMPUTER
U46B,U46D,U54B
INSTRUCTION LOGIC ENABLED AT T3
U36C,U54A
IOO SIGNAL RECEIVED FROM COMPUTER
U95A, U95B, U105A, U105B, U115A, U115B, U124B, U125A, U125B
FIRST DATA REGISTER FF SET AND SECOND THROUGH NINTH FFs CLEARED
U124A
IN/OUT FF SET AT T5 BY CONTROL WORD BITS 14 AND 15
FOR SERIAL INPUT TO THE TELEPRINTER, SET PUNCH FF OR PRINT FF AT T5 BY CONTROL WORD BIT 12 OR 13 RESPECTIVELY
EXTERNAL CLOCK INPUT
U64A, U65A, U65B, U74B U74B, U75A, U75B
B
DIVIDER FFs ENABLED AND COUNTING CLOCK PULSES
U74B
DIVIDER C FF SET AT DIVIDE BY F COUNT
U124A
IN/OUT FF SET?
YES
NO
U74B
DATA REGISTER FFs CLOCK EACH TIME DIVIDE C FF IS SET
ERROR HALT
U14B,U46C
LIA*, LIB*, MIA* OR MIB* INSTRUCTION
C
IOI SIGNAL RECEIVED FROM COMPUTER
8 BITS TRANSFERRED IN PARALLEL FROM DATA REGISTER TO COMPUTER
PRINT FF OR PUNCH FF SET?
YES
NO
Q4,Q9,U24B,U104D
DATA TRANSFERRED SERIALLY TO THE TERMINAL
D
U14A, U35B
HIGHER PRIORITY DEVICE BEING SERVICED (PRH TRUE)?
NO
YES
U15A, U15B, U35B, U45A, U45D
IRQ FF SET AND FLGL AND IROL SIGNALS SENT TO COMPUTER TO START INTERRUPT
U45D
IRQ FF CLEARED AT NEXT T2
U14B, U35B
YES
DOES HIGHER PRIORITY DEVICE USE INTERRUPT?
IRQ FF IS CLEARED TO ALLOW HIGHER PRIORITY I/O DEVICES TO USE INTERRUPT
U14A
FALSE PRL SIGNAL SENT TO INHIBIT LOWER PRIORITY I/O DEVICE
2154-31A


STC, C* INSTRUCTION
U44A
SET CLOCK ENABLE FF ON FIRST INPUT BIT
U36D
CONTROL FF SET
U15B, U25D
FLAG BUFFER AND FLAG FFs CLEARED
U104C
DATA REGISTER INPUT GATE ENABLED
U74B
ENABLE DATA REGISTER WHEN DIVIDER C FF IS SET
A
U114A, U114B
ENABLE DATA OUTPUT TO TELEPRINTER WHEN PRINT OR PUNCH FF IS SET
8 DATA BITS AND 2 CONTROL PULSES ARE SERIALLY CLOCKED INTO THE DATA REGISTER
U15B, U44A, U64A, U65A, U65B, U74A, U74B, U75A, U75B
COUNTER RESET FF CLEARED AT TENTH CLOCK PULSE AND T3
DIVIDER AND CLOCK ENABLE FFs DIRECT CLEARED AND FLAG BUFFER FF SET AT T5
FLAG FF SET AT NEXT T2
DETERMINE METHOD OF DATA TRANSFER
SKIP IF FLAG SET
INTERRUPT
MORE DATA TO TRANSFER?
YES
A
NO
STOP
END OF COMPUTER INTERRUPT PHASE (PHASE 4)
U15A, U15B, U35B, U45A, U45D
IRQ FF SET AT T5 FLGL AND IROL SIGNALS SENT TO COMPUTER
U15B, U16D
IAK SIGNAL RECEIVED FROM COMPUTER AND FLAG BUFFER FF CLEARED
U45D
IRQ FF CLEARED AT NEXT T2
FLGL AND IROL SIGNALS PROVIDE THE TELEPRINTER INTERRUPT ADDRESS TO THE COMPUTER


Q3
DATA REGISTER INPUT HELD AT MARK CONDITION
U124B
FIRST DATA REGISTER FF SET BY Q3 OR FLAG FF
U124B
FIRST COMPUTER INPUT BIT HELD AT MARK CONDITION
TO COMPUTER
U25D
FLAG FF SET AT T2 BY FLAG BUFFER FF
U85A PROVIDES START BIT (SPACE) FOR OUTPUT TO THE TERMINAL
U85A
TENTH DATA REGISTER FF DIRECT CLEARED BY CLOCK ENABLE FF
U85B
ELEVENTH DATA REGISTER FF DIRECT SET BY CLOCK ENABLE FF
Q4, U85B, U114A, U114B, U124A
Q4 HELD OFF BY PRINT, PUNCH, IN/OUT, AND ELEVENTH DATA REGISTER FFs
Q9
Q4 HO
Q9 O

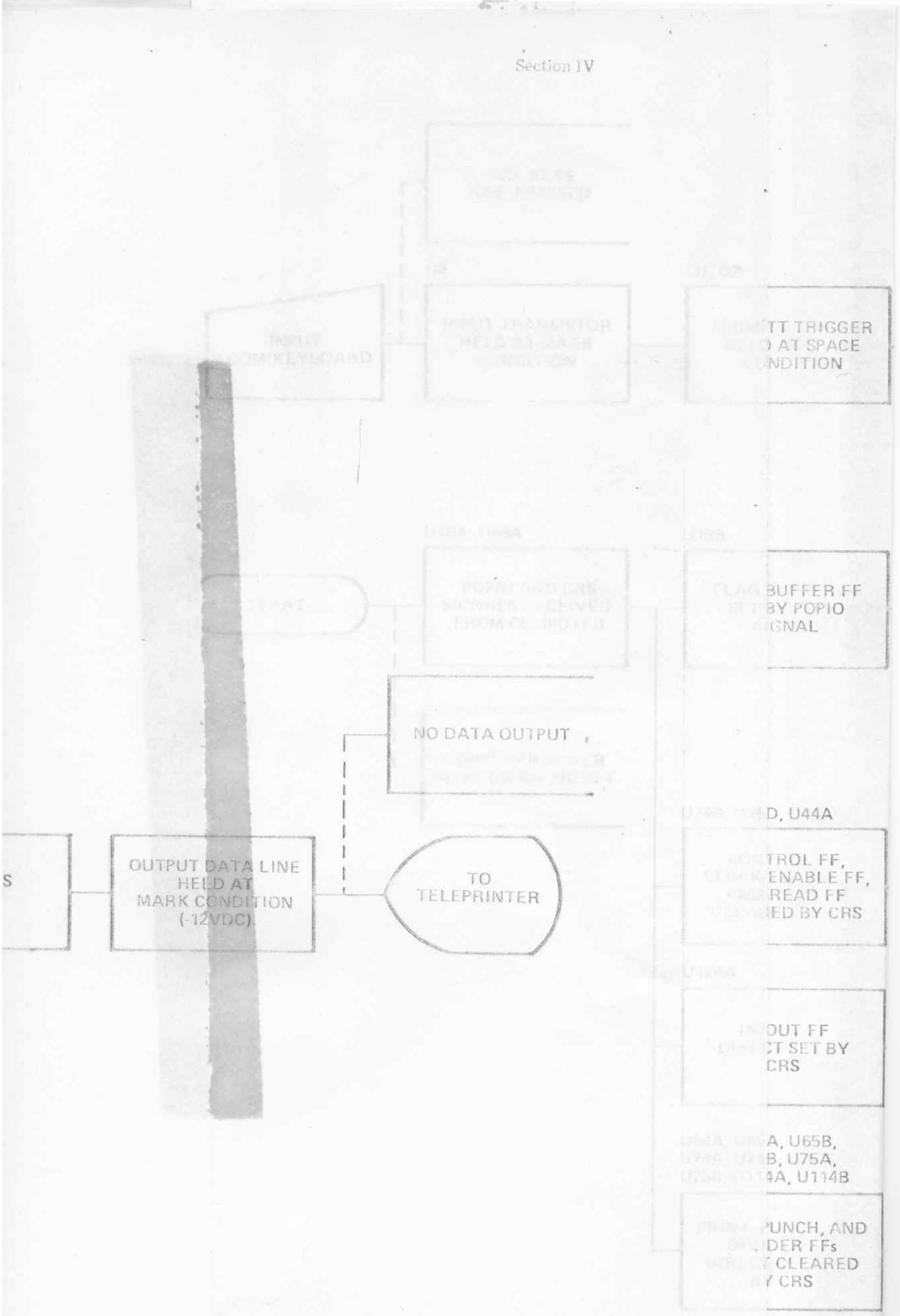
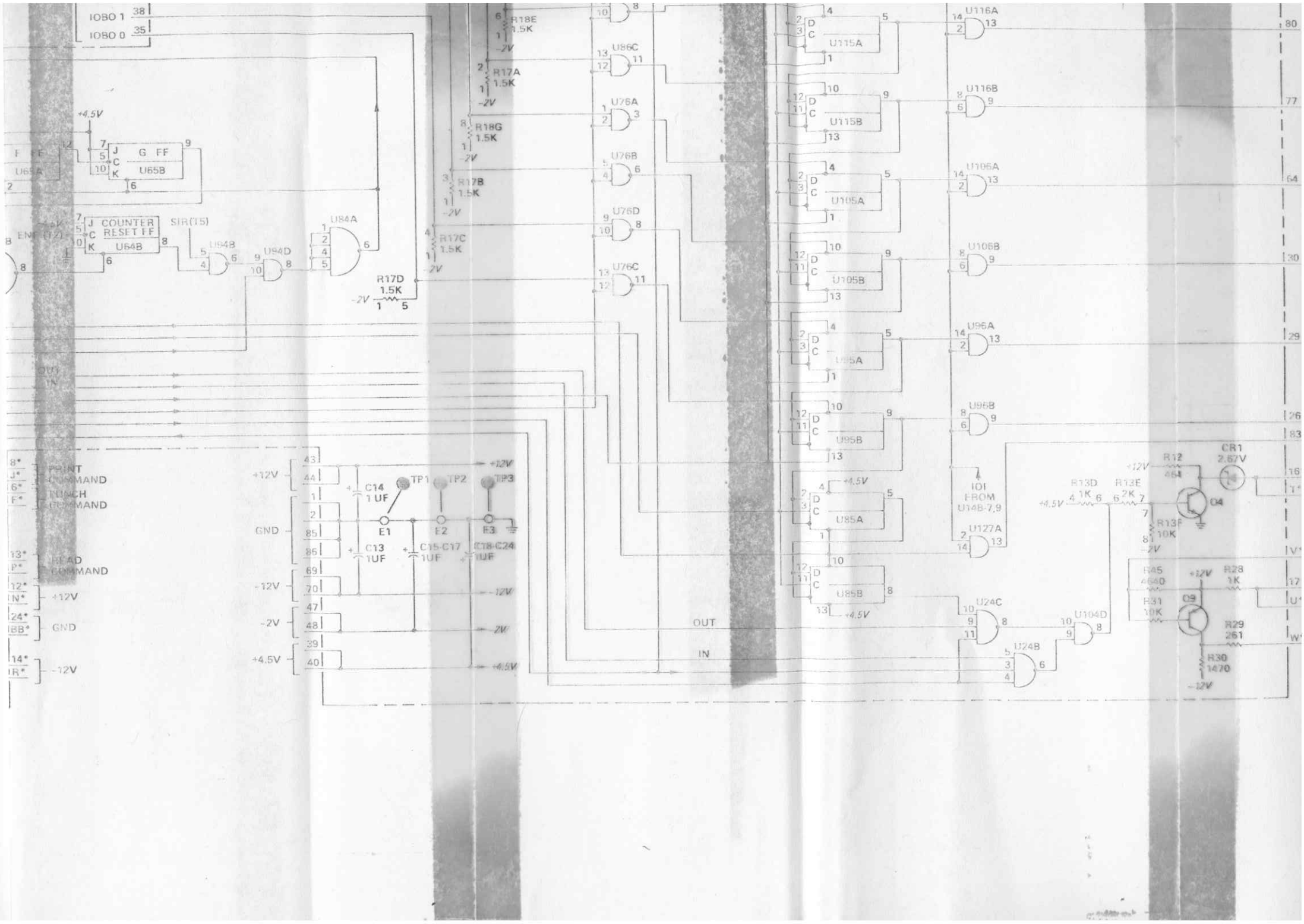
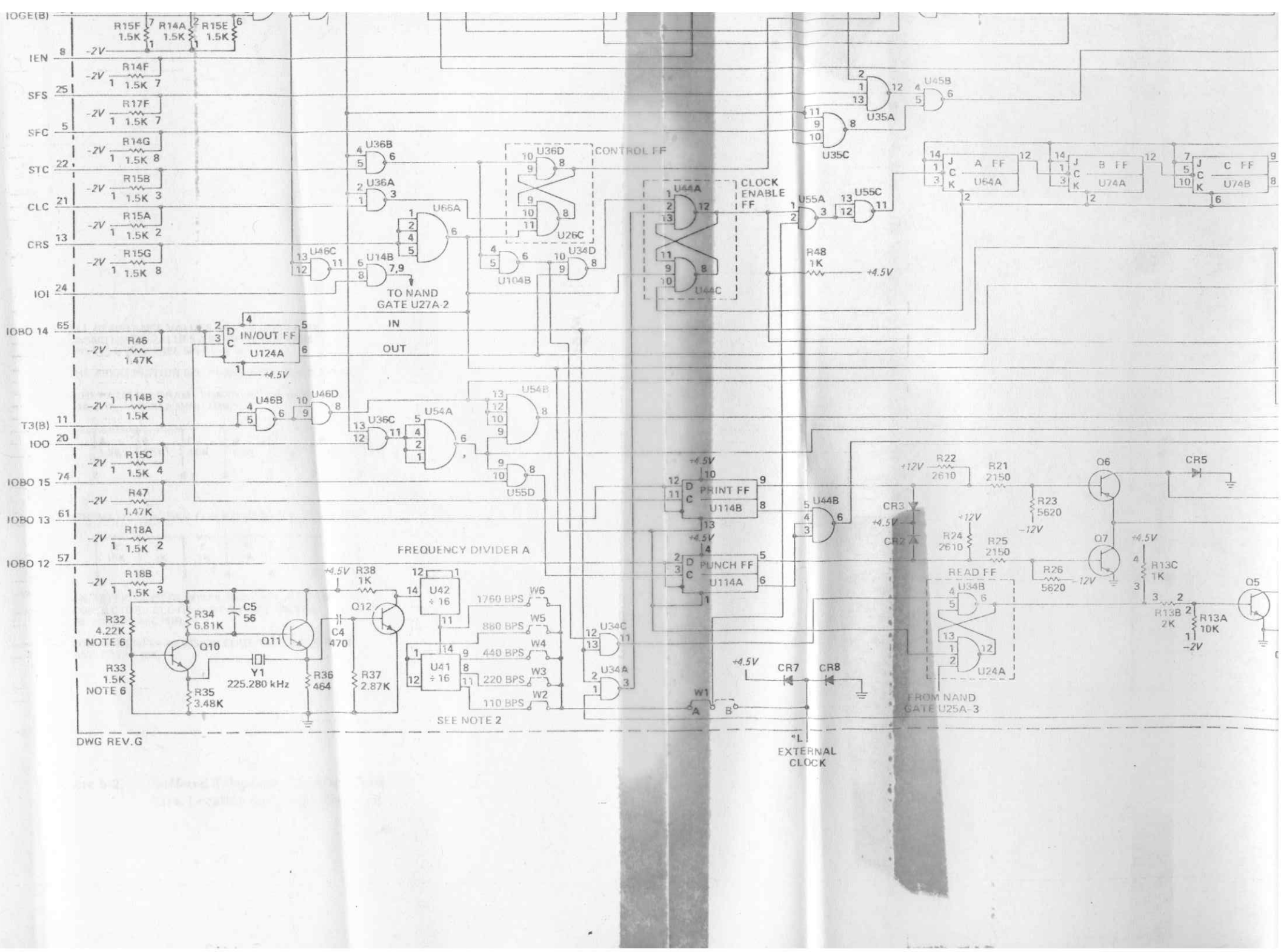
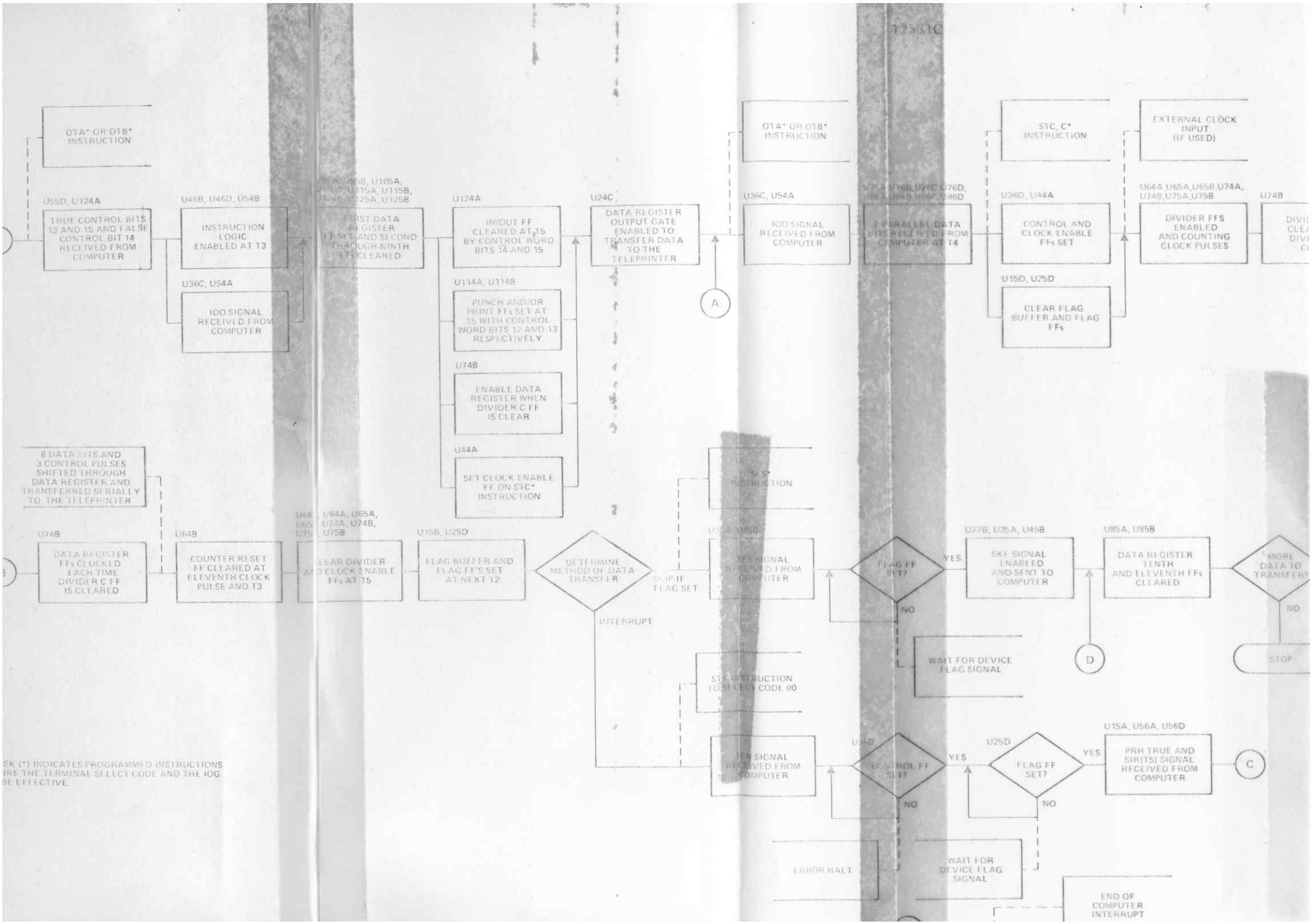



Figure 4-10. Power-On and Preset Switch Functions, Flow Diagram


IOBO 1
IOBO 0
+4.5V
J G FF
U65B
J COUNTER RESET FF
U64B
SIR(T5)
U94B
U94D
U84A
R17D 1.5K
R18E 1.5K
R17A 1.5K
R18G 1.5K
R17B 1.5K
R17C 1.5K
U86C
U76A
U76B
U76D
U76C
U115A
U115B
U105A
U105B
U95A
U95B
U85A
U85B
U116A
U116B
U106A
U106B
U96A
U96B
U127A
U24C
U24B
U104D
101 FROM U148-7,9
R13D 1K
R13E 2K
R13F 10K
R12 464
CR1 2.67V
Q4
Q9
R45 4640
R31 10K
R28 1K
R29 261
R30 1470
PRINT COMMAND
TOUCH COMMAND
READ COMMAND
+12V
GND
-12V
-2V
+4.5V
C14 1 UF
C13 1UF
C15-C17 1UF
C18-C24 1UF
TP1
TP2
TP3
E1
E2
E3
OUT
IN


IOGE(B)
IEN
SFS
SFC
STC
CLC
CRS
IOI
IOBO 14
T3(B)
IOO
IOBO 15
IOBO 13
IOBO 12
R15F 1.5K
R14A 1.5K
R15E 1.5K
R14F 1.5K
R17F 1.5K
R14G 1.5K
R15B 1.5K
R15A 1.5K
R15G 1.5K
R46 1.47K
R14B 1.5K
R15C 1.5K
R47 1.47K
R18A 1.5K
R18B 1.5K
-2V
+4.5V
U36B
U36A
U66A
U46C
U14B
TO NAND GATE U27A-2
U36D
U26C
CONTROL FF
U104B
U34D
U44A
U44C
CLOCK ENABLE FF
U55A
U55C
R48 1K
U45B
U35A
U35C
J A FF U64A
J B FF U74A
J C FF U74B
IN/OUT FF U124A
IN
OUT
U46B
U46D
U36C
U54A
U54B
U55D
PRINT FF U114B
PUNCH FF U114A
U44B
FREQUENCY DIVIDER A
R38 1K
U42 ÷ 16
U41 ÷ 16
1760 BPS
880 BPS
440 BPS
220 BPS
110 BPS
W6
W5
W4
W3
W2
W1
U34C
U34A
R32 4.22K NOTE 6
R33 1.5K NOTE 6
R34 6.81K
R35 3.48K
R36 464
R37 2.87K
C5 56
C4 470
Y1 225.280 kHz
Q10
Q11
Q12
SEE NOTE 2
DWG REV.G
CR7
CR8
*L EXTERNAL CLOCK
CR3
CR2
R22 2610
R21 2150
R23 5620
R24 2610
R25 2150
R26 5620
Q6
Q7
CR5
READ FF
U34B
U24A
FROM NAND GATE U25A-3
R13C 1K
R13B 2K
R13A 10K
Q5




SK (*) INDICATES PROGRAMMED INSTRUCTIONS
IRE THE TERMINAL SELECT CODE AND THE IOG
BE EFFECTIVE.

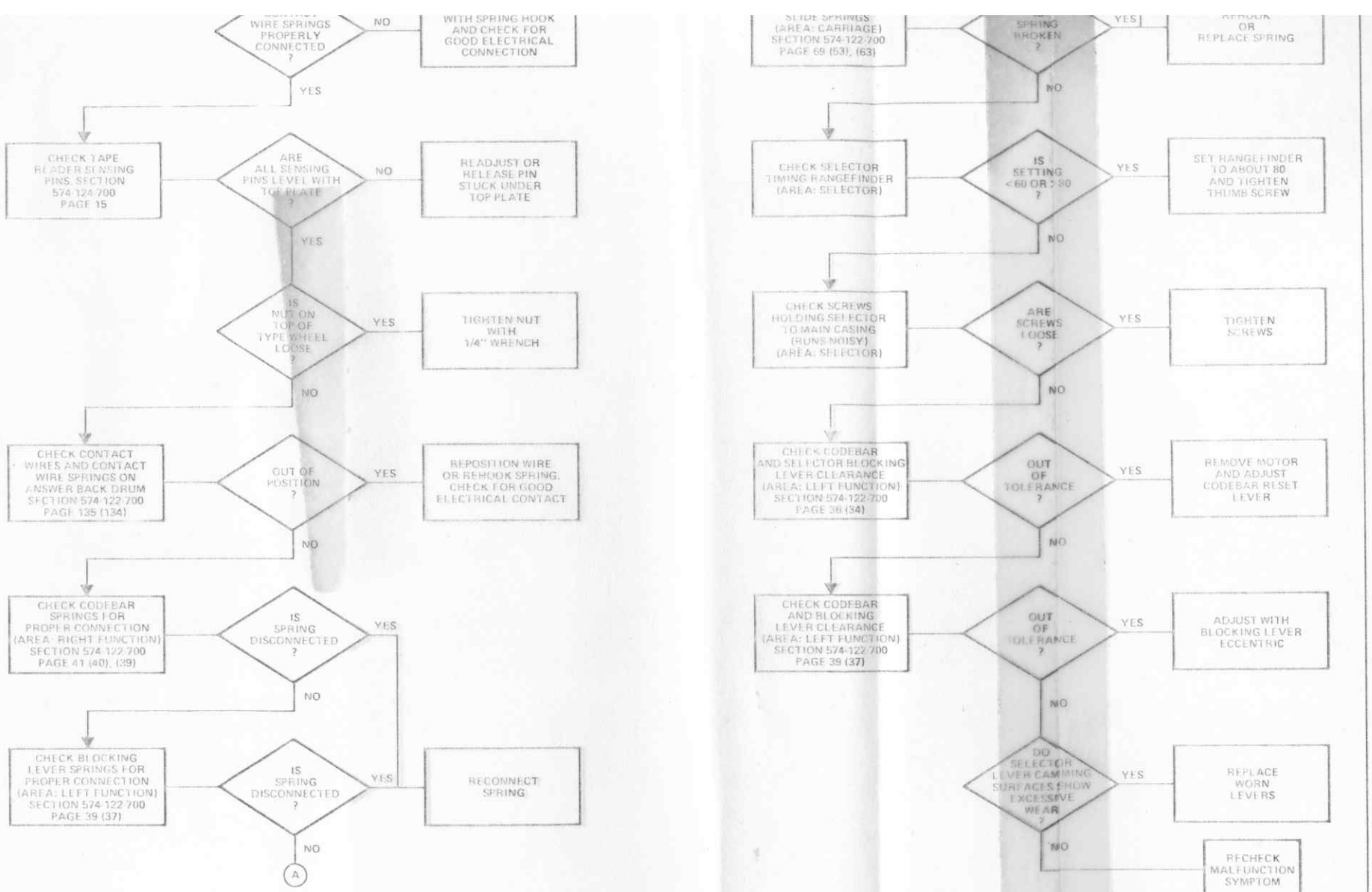



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Figure 5-10. Troubleshooting Flowchart, Prints Improper Symbols